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PROFESSIONAL PAPER

Flexible Transportation of Passengers and Combined Mobility

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Abstract: The paper describes the importance and the role of the subsystem of flexible transportation of passengers (paratransit) in the system of a public city transportation of passengers (PCTP). It is a system with several forms and can be defined by several parameters, but in large number of cities in the world it gains more importance in the PCTP system. This paper describes this system with its characteristics, i.e. its positive characteristics that lead to increased combined mobility of population in cities in the PCTP system, i.e. to decreased use of passenger cars.

Key words: Paratransit, public city transportation of passengers, combined mobility.

INTRODUCTION

Flexible transportation of passenger or paratransit – FTP, is a subsystem of the public city transportation of passengers and by its concept it is between the passenger car and the standard bus subsystem of passenger transportation in cities.

This subsystem is defined opposite to the institutional public city transportation of passengers (PCTP) and it based on the planned transport service. It is often classified as "informal" or even "illegal" transport, organised at the border of the institutional transportation system, sometimes taking the role of the main component of the passenger transport system [10].

In developed cities of the world today, the planning of city transportation system cannot be imagined without a balanced city transportation system and mutual cooperation between various forms of subsystems for transportation of passengers. In this way the passengers (users), can travel by combining several subsystems, but while each of the subsystems performs the role most suitable for it, both physically and operationally. This concept achieves overall convenience for the users while at the same time raising efficiency of the transportation system in an optimal way.

Regardless of the size of a city, the said concept is realised through a strategy of sustainable development and quality of life.

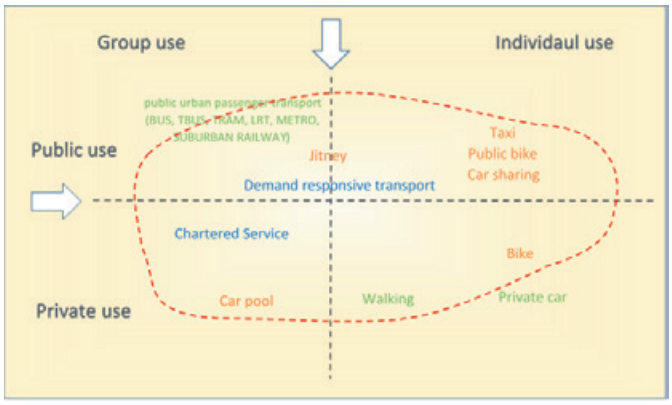
City's sustainable development strategy is an integral, economic, social and cultural development of a city (including its transportation system), harmonized with environmentally acceptable norms and standards, enabling present and future generation to meet their needs and improve their quality of life. A quality of life strategy is a subjective multi-dimensional concept that defines the level for emotional, physical, social, material and other prosperity.

In the European Union, achieving "sustainable development" and "quality of life" goals in terms of public transportation systems is achieved by running a policy that uses mobility of the population with limited use of passengers cars as its principle. The policy and measures of European countries in "sustainable development" are shown in table 1 [10].

Table 1. Policy of European countries in the development of cities suitable for living

SUSTAINABLE DEVELOPMENT OF CITIES (mobility with controlled use of passenger cars)	
Resource management (re-orientation of city functions Car usage management functions)	Pedestrian zones Zones protected from motor traffic Limited access to passenger cars to certain zones or at certain times Calming (slowing) the traffic Parking management and charge Traffic management

Development and management of Public Transport (building systems, development, integration and quality)	Reservation of land and priorities Operational system management Information systems for users Development of paratransit
Planning and taxation mechanisms (Development management, limitation in use of passenger cars, financing the development)	Planning and use of land (reserving sites for railway subsystems of public transport) Taxes (sale of real estate, valorising the site and commercial values) Payment zones Licencing of areas (controlling entry to the centre, circulating in the centre with tickets, etc.) Charging road tolls (toll stations, charging per length of the section, etc.)
Organisation and financing	



Picture 2. Schematic diagram of combined mobility

Global trends in the development of public transport systems that were based on the strategy concerned to satisfy essential needs of the largest "group of citizens" (providing accessibility in space and time, financial support and monitoring of the realisation of planned and contracted services) moved to the strategy of "concerns for satisfying specific needs of small groups of citizens" (decreasing congestions, protection of the environment, principle of competing for subsidies, satisfying said strategies of carriers depending on their capability to satisfy various needs of users of the public transport system, principle of coordination between transport companies).

In other words, the contemporary systematic approach to managing public transportation system is a concept where the public transportation is moving from a "system for itself" to becoming a "subsystem of the system of the city and surrounding residential areas".

In more narrow sense, this means that we are moving from the strategy of "a passenger that needs to be transported" to the strategy of "a user that needs to be served", i.e. from the strategy of "service quantity" to the strategy of "satisfying specific needs of all users of the system in a quality way".

Successful cities and cities suitable for life rely on an efficient PCTP system to realise the travel, which in synergy with the paratransit systems provides to the users of transport - passengers a combined transport service, so-called combined mobility service.

Picture 1. Combined mobility platform

Combined mobility is the result of work – synergy of the PCTP system and the paratransit system, and together with walking on foot they make the complete and coherent solution to realise transportation needs of citizens in urban areas. In the combined mobility concept various modal subsystems are coordinated in such a way that the users can conduct their travel by combining several modalities, but each modality performs a service that is most physically and operationally suitable for it. Combined mobility is a powerful tool in the process of creating a balanced PCTP system. By implementing and developing the concept of combined mobility we achieve overall convenience for users, and on the other side productive and economic efficiency of the transport system is raised to the optimum [11]. This concept today is becoming an important part of the sustainable transport strategy, with very significant influence and usefulness for the quality of life for citizens, the most important being:

- Changes the habits of users in realising their transportation needs and encourages redirection to sustainable modalities of city transport of passengers,
- Saves public place, because it decreases use of private cars,
- Influences modal distribution of motorised movement in a city, because it increases the number of users of the PCTP system.
- Encourages increased dynamics of the city's system for transportation of passengers, and contributes to creating a more efficient and effective subsystem – PCTP.
- Influences that the transport service provides a more flexible and comprehensive way,
- Decreases time of travel as one of the basic elements of all forms of quality according to users of the public city transportation of passengers,
- Decreases costs of travel compared to the use of private passenger cars,
- Contributes to sustainable development and quality of life in city agglomerations.

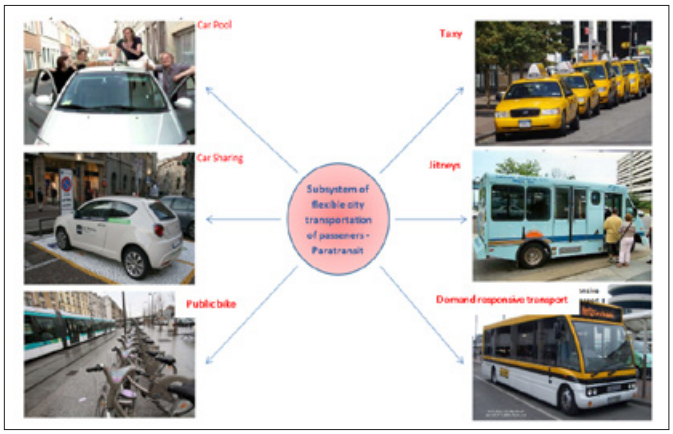
Periods of change, colloquially called a transition, envelop all segments of social and economic development of the countries in the region. The transition process in the structure of change in ownership relations, carries with it transfers of capital being invested in new technologies, sets new development strategies and reaches greater levels of competition in the market. The state acts as a regulator of economic development, in terms of creating a climate, most often by adopting regulations and creating equal market conditions. In order to ensure favourable and reliable investment climate in the area of services in the city public transportation system, it is necessary to create suitable climate, above all within process and substantive regulations defining conditions for operation and behaviour of businesses [17].

SYSTEMS OF FLEXIBLE TRANSPORTATION OF PASSENGERS

A division of flexible transportation of passengers can be made based on different characteristics that make this system different, but the usual division is according to the technical-technological characteristics criterion.

Based on this, the dominant forms of flexible transportation of passengers are (Picture 3.) [10]:

- taxi transport;
- modified use of personal vehicles - cars (so-called "carpool");
- semi-public transportation, i.e. transportation available only to a set of users (e.g.: residents of a zone, members of a business system or organisation), and which is realised by rented vehicles (buses, mini-buses,…);
- jitneys, i.e. taxi transportation over predetermined routes or corridors;
- group transport towards several individual calls (satisfies public transportation service in the "zone" between taxi transportation and public line transportation of passengers, with the route of the vehicle is formed according to concrete calls and needs);
- public bicycles;
- individual transportation on call (similar to taxi transportation, with the transportation performed by the people who do not do this full time).



Picture 3. Subsystems of flexible transportation of passengers

Joint use of private cars (carpool) is a subsystem of flexible city transportation of passengers, available to certain number of users in space and time. This joint use is achieved through various forms of car rentals or, more often, group transportation by private cars in movement lines, such as commuting to work [1].

Car sharing is a form of semi-public service in which the user individually optimises the realisation of the service in accordance with transportation needs. Use of such service is based on a community (membership in a group or a club).

Taxi system in most of cities is an important component of the total city transportation of passengers. It is a mode of public transport conducted in standard or specially adapted passenger cars (Picture 4.). It performs individual trips, i.e. "door-to-door" trips [2] [3].

Picture 4. Taxi vehicle

Jitneys are a form of flexible transportation of passengers that provides transportation services over a predefined (fixed) route, but without a timetable [5].

This service is provided in vehicles with relatively small capacity (up to the minibus size, Picture 5.). Along the route the entry or exit of passengers from the vehicles is conducted at predetermined locations or on user's request.

Picture 5. Minibus operating as paratransit

Demand responsive transport (call) is a type of semi-public and public transportation of passengers that provides service to individual users, over flexible routes, in flexible timeframes. In other words, demand for services and offering transportation service is constantly harmonised with the aim to be adjusted to individual requests, i.e. users.

In comparison to factors that more closely determine the character of the transportation service (such as the route, stops, time, reservations, etc.), there are different variants of this type of flexible transport:

- with **fixed characteristics of services over a corridor.** Static and dynamic elements are defined similar to line transportation, with possibility of deviations in accordance with changes in transportation requests and decisions of operators. The flexibility is most often reflected in that the departures are fixed on one part of the route, while on the other they are adjusted and extended according to needs. Issuing a request for transportation is conducted before or during the service itself (stopping the vehicle on the route).
- with **semi-fixed characteristics on a corridor**. According to this modality the base route, stops and timetable are defined. Departures of vehicles are conducted independently from issued transportation requests. If there are special requests, the vehicles can stop on other locations along the corridor (which is a problem for the operators, and the reason they ask for a request for transportation to be issued).
- with **flexible characteristics and defined stops over the service area.** This concept involves organising service realisation over a set service area (region and/or corridor) with defined stops where the service is performed (entry/exit of passengers) in accordance with issued requests and route optimisation by the operator according to different criteria (minimising the route length, minimising waiting times for users, minimising number of vehicles, etc.). A frequent modality is contracted transportation with certain subjects (businesses, institutions,…) according to which multiple starting points and one destination is defined, and vice versa, one starting point and multiple destinations.
- **''door-to-door".** This concept is organisationally most demanding, but the most flexible mode of transportation. It is suitable for users with limited capability to realise mobility needs. It is realised by grouping requests for transportation into one ride (so-called "group" taxi).

Public bicycles are a subsystem of flexible public city transportation of passengers available to users as a public service to realise transportation. The users realise or complement their transport needs by using public bicycles, optimising the transportation process by themselves.

The greatest positive characteristics of paratransit that it can be harmonised with other modes of public city transportation of passengers, in forms that are specific for each environment, but especially with line transportation of passengers.

DUALITY OF THE PUBLIC CITY TRANSPORTATION SYSTEM - FLEXIBLE TRANSPORT SYSTEM

In most of the cities in the world there are mostly two passenger transportation systems: institutional - PCTP and flexible. They work according to very different models and coexist in a complex relationship that varies from one to the other context. Institutional transport involves public passenger transportation services that are often referred to as planned or regular transportation services on line routes according to a predefined timetable. That means that public of private companies of a formal structure provide transportation services according to regulations defined by the competent body of that city (appointed by the city administration). These carriers develop their networks in accordance with quality standards of the transportation services defined (imposed) by their management body, with often low prices

of transportation due to them being subsidised by the local authorities.

Flexible transportation of passengers often works on the "periphery" of institutional one, although sometimes in cities that do not have good and quality PCTP system (mostly smaller cities and towns) it takes over the main component of the PCTP system [6] [7]. In several documents that analyse public transportation of passengers in several cities, it is often described as poorly organised and inefficient sector in terms of transportation of passengers. Critics of flexible transportation also point out disloyal competition that severely punishes institutional transport. Experts that often believe that this subsystem is even harmful for the whole of city passenger transportation system still believe that the presence of flexible transportation is justified.

Flexible transportation meets those types of transportation requirements that generally only this transportation system can satisfy. As we said, in many cities this is the only available type of transportation. This system, in a pragmatic way is adjusting to the local context in cities where the institutional framework is inadequate or inefficient and where topography and geography become an obstacle for the development of bus lines. Along with that, unlike the PCTP subsystem which is under the authority of the city administration, services of flexible transportation have the ability to adjust to the expenditures of the city population. In order to study potential possibilities for coordination of flexible transportation and the PCTP it is necessary to understand basic business models of both types of services. Specifically, institutional PCTP is established by the city authorities (who are responsible for this system) who invest into the public transportation service. The authorities impose business conditions through subsidies and donations to the system, because it cannot cover on-going operational expenditures of carriers nor provide necessary funds for the development of this system. However, balancing quality and quantity (giving advantage to profitability) often results in: decreased road worthiness of the vehicles, poor organisation of the system, increased age of vehicles, causes disruptive competition amongst carriers, which is generally harmful for public transportation of passengers.

As far as the flexible transportation services are concerned, they are a result of private initiatives, i.e. carriers, which are developing spontaneously. The main goal of carriers is to survive at the transportation market and increase their profit. Due to the above, operation of the institutional PCTP system and the paratransit system can easily come into conflict [8] [9].

Recent research in large number of cities of the world shows that these two components of the public city transportation are in fact potentially complementary. These researches confirm a large share and importance of the flexible transportation subsystem in the total transportation system of each city.

Specifically, in a balanced city transportation system different modal systems are coordinated, so that users can easily travel by combining several subsystems, but while each of the subsystems is performing the role both physically and operationally most suitable for it.

On the other hand, many Case Studies in a wide spectrum of urban situations focused on the specific role that each type of service has in the city and on the operational relations achieved between the flexible and institutional transportation.

CONCLUSION

The strategy of UITP (International Association of Public Transport), in relation to the sector of the public city transportation of passengers aims at doubling of the market share of the PCTP system by the end of 2025.

Successful cities and cities suitable for life rely on efficient PCTP to realise their trips, which in synergy with the subsystem of flexible transportation of passengers provides users with a combined transportation service, i.e. provides the citizens of an urban area a so-called combined mobility service.

Combined mobility is the synergy of the system of public mass transportation of passengers and the system of flexible transportation of passengers (paratransit), and together with walking on foot they make the complete solution to realise transportation needs of citizens in urban areas.

However, balancing quality and quantity (giving advantage to profitability) often results in: decreased road worthiness of the vehicles, poor organisation of the system, increased age of vehicles, causes disruptive competition amongst carriers, which is generally harmful for public transportation of passengers [12].

One of the key characteristics of paratransit is that there are no direct subsidies by the local or national authorities (this excludes the use of urban infrastructure which is sometimes considered as indirect subsidies). The only source of income in this sector is the paying passengers. In general case, there are three financing options: through loans, through personal savings of carriers or through informal loans.

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