Proceedings of 23rd International Scientific Conference. Transport Means 2019.

RAIL PASSENGER HUBS

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Abstract

The question about the organization of transport passenger HUBs in Ukraine has been raised at the conferences of Ukrzaliznytsia for several years, but each specialist understands this issue in different ways. The authors of the article have set the purpose to determine what the rail hubs are needed for, what conditions are necessary for their construction, what functions the HUBs will perform and what theoretical structure they have. For the first time in Ukraine, we formulated the complex task concerning the organization of railway passenger transfer centres, formulated the refined terminological definition of the ***rail HUB***, with the simultaneous operation of transfers, which will significantly reduce the travel time and improve the comfort. To solve this issue, we used a systematic approach allowing to determine the refined terminological definition - the railway HUB, the purpose they are built for, the places of their construction, the main functions and the volume of services rendered. The necessary conditions for the construction of rail HUBs have been determined. The refined terminological definition of the ***rail HUB*** and the sphere of rail HUB as a combination of socio-economic relations have been proposed. The transfer variants have been considered. Implementation of the new functions of transport transfer centres (hubs) will allow the management of JSC "Ukrainian Railways" to create additional amenities for passengers and improve the quality of their services by optimizing train schedules, reducing travel time, providing additional transfers for passengers and luggage, as well as shopping and entertainment services.
Key words: passenger railway stations, hubs, HUB functions, schedule of trains, travel time, passengers and luggage transfers.

1. Introduction

A significant part of their life people travel by various types of transport to carry out business assignments, negotiations with partners, suppliers, potential clients, for the purpose of tourist trips, recreation, conducting scientific research and cultural events. But not always the final destination of the trip can be reached by one type of transport. Railway transport, even within one country on the same continent, in advance requires the transfer of passengers from one train to another. Sometimes to reach your destination, you need to travel consistently by several modes of transport.

This was the case earlier, but in order to increase the comfort of transportation and to reduce the travel time significantly, they began to build transfer centres in large cities of different countries, whose purpose is to link schedules of airplanes, trains, and other modes of transport between themselves and to create all possible comfortable conditions for passengers (hotels, lounges, restaurants, cafes, shops, places of entertainment, etc.) waiting for a further trip.

Review of recent publications. Publications on the organization of HUBs are mainly in foreign literature and concern mostly the airports.

Initially, these passenger hubs were created only at major airports. An example is the Hartsfield-Jackson Atlanta International Airport, situated 11km south of downtown Atlanta, Georgia, USA. It is the world's busiest airport by passenger traffic and by number of landings and take-offs. The airport has 196 gates. Most of the flights are domestic to different US airports with transfers or flights to smaller cities in the Southern States of the USA.

Hartsfield-Jackson International Airport serves international flights to North America, South America, Central America, Europe, Asia and Africa. As an international gateway of the United States, *Hartsfield-Jackson* ranks seventh; the first position belongs to the John Kennedy International Airport in New York. Nevertheless, the number of international flights at the airport is increasing. In total, around 5 million international passengers use the airport services annually. The airport is located partly within the city of College Park, which is situated south of Atlanta, but most of it is located in the Fulton and Clayton counties that are not part of the locality; also, the airport's territory lies on

the land of the cities of Atlanta, East Point and Hapeville. You can get to the airport using the MARTA transport system.

Then such transfer centres began to be built on railway transport. An example is Skolkovo Transport HUB.

The transport hub on the Minsk highway should become one of the stops of high-speed trains between Moscow and Odintsovo.

High-speed trains are one of the main hopes of the inhabitants of Odintsovo who are in the traffic trap every day. Traffic jams, reconstruction of railway platforms and overcrowded trains make the way to work for the majority of the city's residents a real challenge.

The construction of the Skolkovo Transport Hub will be completed in 2019. The facilities included in the multimodal transport cluster will be built simultaneously. There will be constructed a stop-transfer station, a 400-meter pedestrian crossing through Minsk Highway and an office centre. The construction will cost 170 million dollars. At the same time, the Russian Railways company is laying the third and fourth main tracks, as well as is erecting the railway platforms.

After opening the high-speed railroad traffic between Skolkovo and the Belorussky railway station, the way to the Skolkovo Innovation Centre will be about 23 minutes. Near the railway they will build a tower, consisting of 21 floors, housing exclusively offices and shops.

The Skolkovo multimodal cluster will combine several means of transport. In the vicinity of the station, a bus turn-around area will be organized and a ground parking for 200 cars will be made. In the subsequent stages of the development of this zone, it is foreseen to create up to 1,200 parking places. Open ground parking spaces will be organized on the 50 meter wide strip of about one kilometer in length.

Another authors present a library of classes implemented in Python, which could be used for computer simulations of public transfer nodes [1]. On the grounds of simulations with the use of mentioned models, solutions for complex problems in the area of public transportations were obtained, such as synchronization of bus lines in a transfer node, estimation of the optimal bus number for a public transport line, designing the rational network for a public transport system, etc.

In the research [2] the authors developed a data-driven, generic and passenger-oriented methodology for systematically determining where in the network, and for which lines transfer synchronization should be prioritized in the TSP, so that the TSP becomes solvable for larger, real-world urban PT networks. Their study thus introduces two steps preceding solving the TSP – identify key priorities (a) where to synchronize, and (b) which lines to synchronize.

Another authors formulate mathematical models determining the location of hubs, designing the hub networks, and routing the demand in order to maximize profit [3].

A methodology of the multimodal transport management support systems development in [4] is elaborated based on the theoretical analysis of the information from various sources on multimodal transport system concept, transportation systems management technology, and other researcher's studies on planning multi-modal transportation systems. The proposed methodology of multimodal transport system management support systems development includes three subsystems or modules: transport traffic control support system, transport traveling time synchronization system, and user support system. The proposed by authors public transport bimodal node development methodology was successfully tested on the Terminal bimodal transport hub "train - international bus".

Publications on the organization of HUBs are mainly in foreign literature [5-17].

In Ukraine, this matter is being investigated only at scientific conferences and in the apparatus of JSC "Ukrainian Railways". But it needs further research, since large cities have long formed the transport infrastructure, which is squeezed by urban buildings [18].

2. Purpose of the study.

The hub is a nodal element of the planning structure of the city with transport and public purpose, which provides the transfer of passengers between different types of urban passenger and foreign transport or between different lines of one mode of transport, as well as the accompanying servicing of passengers by the social infrastructure facilities. The hub may include: terminals, intercepting parking lots, taxi-ranks, etc. The hub terminal is a specially created one or several structures within the transport hub designed to optimize the pedestrian flows of the passengers making a transfer, with the option of visiting their service facilities or bypassing them.

The question about the organization of transport passenger HUBs in Ukraine has been raised at the conferences of Ukrzaliznytsia for several years, but each specialist understands this issue in different ways. The authors of the article have set the purpose to determine what the rail hubs are needed for, what conditions are necessary for their construction, what functions the HUBs will perform and what theoretical structure they have.

3. Originality.

4.

For the first time in Ukraine, we formulated the complex task concerning the organization of railway passenger transfer centres, formulated the refined terminological definition of the ***rail HUB***, with the simultaneous operation of transfers, which will significantly reduce the travel time and improve the comfort.

5. Methodology.

To solve this issue, we used a systematic approach allowing to determine the refined terminological definition - the railway HUB, the purpose they are built for, the places of their construction, the main functions and the volume of services rendered.

6. Findings.

Conditions for formation of passenger HUBs. The following conditions are required for the construction of rail HUBs:

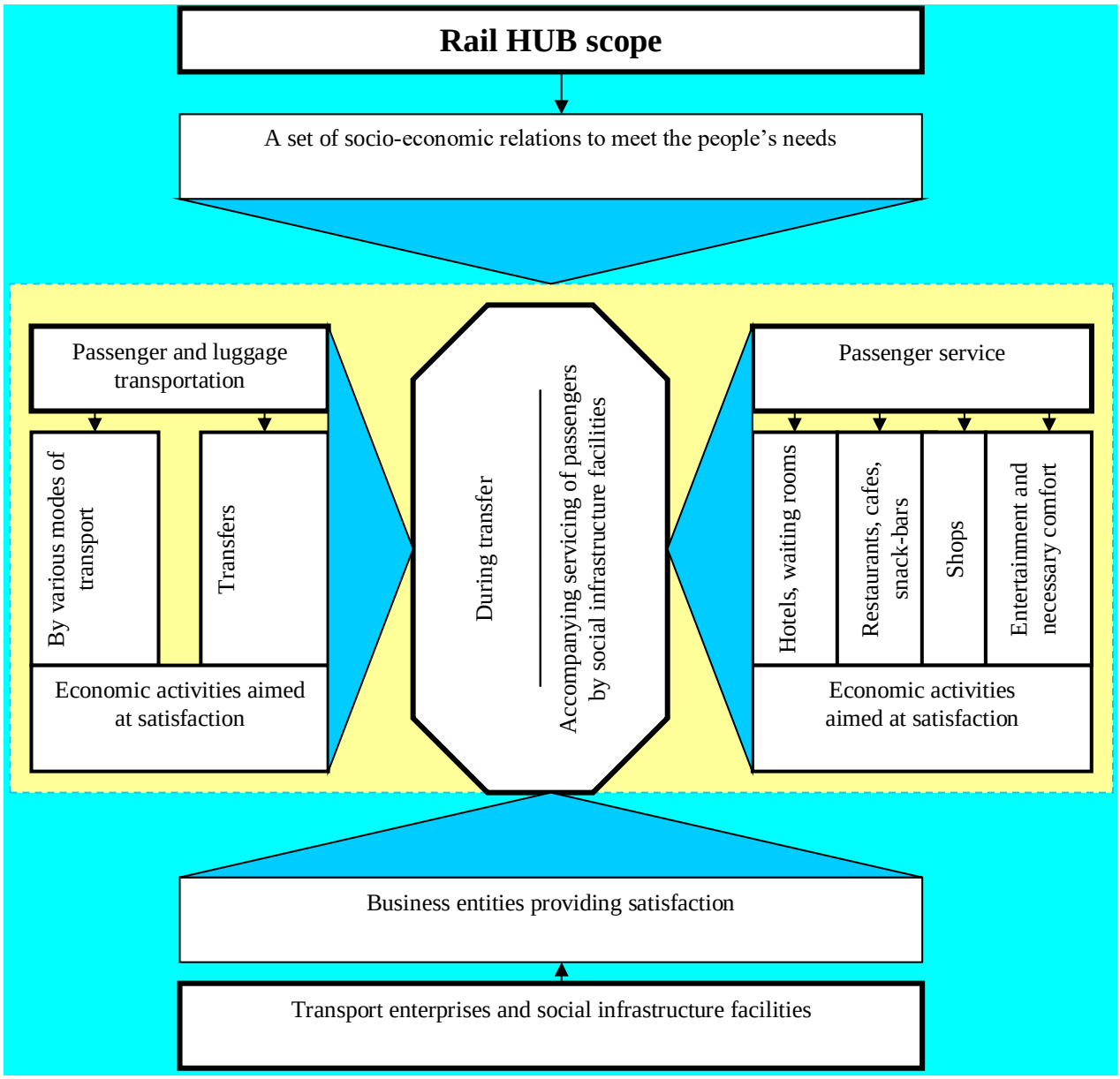

Figure 2 - Scope of engagement of other modes of transport within the main rail HUB. *Source: Authors' development*

1. Availability of a large number of trains of different directions and categories from which the passengers change to other trains and modes of transport for continuing their trip;
2. The rail transport HUB should combine all types of general and urban transport. If provision of rail HUBs with city transport (metro, tram, bus, trolleybus, taxi, etc.) is quite real, then it is almost impossible to get airports, bus stations, marine and river passenger terminals in one place. For this purpose one can offer transfer services that will work in one connection with the above stations, and whose service cost to be included in a single transport ticket.
3. Existing large railway stations in Ukraine cannot be considered HUBs, since the existing technology of passenger transportation does not involve the connection of the schedule of commuter, passenger and high-speed trains with other modes of public transport, organization of transfers and the use of a single ticket. For example, an ordinary railway station in the big city of Kyiv, which has all kinds of urban transport and buses carrying passengers to Boryspil, Zhulyany, bus stations and river terminals, cannot be considered HUB, since the schedule of passenger trains is not connected with other modes of public transport, there is no organization of passengers and luggage transfers. There are

not enough comfortable hotels, waiting rooms, restaurants, cafes, shops, places of entertainment and convenient transfers to local transport nearby.

4. The desire of the municipal government for new construction and reconstruction of the railway station territory. And for this purpose, it is necessary only in Kyiv to build horizontal escalators for the transfer of passengers to the metro and tram, covered parking for shuttle buses, taxis and trolleybuses, connected with the train station concourse, an escalator and the organization of the constant movement of modern electric trains to Boryspil airport. At the same time, it is necessary to decide on the targeted delivery of luggage to other types of public transport. It should be noted that local transport is part of the prerogative of local authorities, but is carried out in tandem with Ukrzaliznytsia.

Figure 2 shows the principles of operation of the main rail HUB with other HUBs, or destination points. For example, in Odessa, where there is a marine station and an airport, it is necessary to introduce transfer buses in these directions. In Kiev, where there are two airports and one river station, it is necessary to arrange a shuttle bus to Zhulyany, a transfer by road and rail (high-speed electric train) to Boryspil airport, and transfer by road to the river station.

With the development of technology the transfer can be carried out by helicopters, rail vehicles and narrow-gauge trains in the Transcarpathian region (Mukachevo railway station).

Taking into account the above, it is possible to propose a refined terminological definition *of the **rail HUB** – it is a large railway transportation centre for organizing a comfortable trip of passengers and their luggage, traveling by several types of transport, the movement of which is coordinated by one general traffic schedule, with a single ticket, which includes the cost of all types of services and thus provides full comfort to passengers during the period of waiting for a further trip.*

The scope of work of the railway transfer centre exists within the economic system to meet the requirements of the social system. To provide the railway HUB services and the related services for passengers by social infrastructure facilities there are various business entities that use specific technical and technological resources, the work of professionally trained workers, have a peculiar mechanism of pricing and tariff-setting, accounting, incentives and consumer motivation, territorially scattered mode of operation, which in its general perception is a necessary, inherent, compulsory and special part of the economic system as a set of all types of economic activity of people, which is aimed at the production, distribution, exchange and consumption of goods and services.

But the main goal of HUB construction is to reduce the travel time of passengers and provide them with comfortable conditions.

Summarizing the foregoing, one may state that the ***sphere of rail HUB is a combination of socio-economic relations associated with the movement of passengers by various modes of transport and transfer, as well as their accompanying servicing by social infrastructure facilities for the provision of full range of services throughout the journey.***

It follows from the foregoing that a railway hub cannot exist without transfer services, general traffic flow and a large number of passengers. It cannot be the other way, because there is almost always a distance between the rail hub and airports, river and marine terminals, which many passengers want to cross over in time and continue their travel.

7. Conclusions.

1. Based on the information on the world's passenger hubs, the refined terminological definitions of rail HUBs and their areas of operation are proposed.
2. The principles of their organization, place of their formation are established.
3. The types of transfers for the efficient operation of railway HUBs are proposed.

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