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Principles of determining the basic functions of railway hubs

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Abstract

Goal. During the past two years the question about creation of passenger transportation hubs has been raised at the conferences held by Ukrzaliznitsya (Ukrainian Railways). And it became evident that every specialist has a different understanding of the concept. At the moment, several railway junctions for the passenger hubs have been chosen. These locations are Kiyiv, Kharkiv, Dnepr, Lviv and Odesa. The developers' goal is to set functions of these hubs and to improve them due to optimization of train schedule, shortening of trip time and providing passengers with comfortable conditions.

Results. The work analyzes the existing functions of railway stations and provides a list of some new functions that can be introduced to transform existing stations into railway transport hubs.

Practical significance. The implementation of the new passenger transportation junction functions listed in the work will allow the management of the Ukrainian Railways to provide additional facilities for passengers and improve the quality of services due to train schedule optimization, reducing travel time, providing additional transfer services for passengers and baggage as well as shopping and entertainment services.

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Keywords: passenger stations, transport interchange nodes, HUB functions, train schedule, transfer of passengers and baggage.

1. Introduction

There are several definitions of the term HUB on the Internet and in the literature. Hub (literally - wheel hub, centre) is in the general sense, a junction point of a network.

- In aviation (in English, often a *gateway*) is a hub airport, a sufficiently large interchange and reloading transport hub with the necessary set of services, having a suitable geographic location.
- In transport - a transfer, reloading point.
- On off-road vehicles, it is a freewheel clutch for the front, connectable, axle. There are manual and automatic hubs.
- In computer technology and networks, it is a network hub (for example, a USB hub).

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- In the Direct Connect file-sharing network, hubs are network servers.
- In Fidonet, the hub is the main node through which the mail is sent.
- In power engineering, a hub is a specialized distribution centre that divides one route into two or more.
- Habs is the nickname of NHL team Montreal Canadiens.

But we are interested in the transport concept of HUB. The Wikipedia says it is a transport interchange, where traffic flows converge. Initially, this term was used for large airports, where the passengers transferred from one direction of travel to another. Subsequently, the term HUB began to be used for any transport interchange points. Taking into account the above, it is possible to organize railway HUBs for convenient passenger travel in Ukraine.

Publications on the organization of HUBs are mainly in foreign literature [4-10]. In Ukraine, this issue is investigated only at scientific conferences and in the office of PJSC "Ukrainian Railways" [1-3]. But this issue will require further research, since large cities have long been formed transport infrastructure, which is squeezed by urban buildings.

2. Purpose of the study

For two consecutive years at the conferences of Ukrzaliznytsia the question arises about the organization of transport passenger HUBs in Ukraine, but each specialist understands this issue in different ways. Now even there are defined a few railway junctions, where the passenger HUBs will be organized: Kiev, Kharkiv, Dnipro, Lviv and Odessa. The authors of the article set out to define the functions that HUBs will perform and to improve them by optimizing the train schedule, reducing the travel period and providing maximum comfort for passengers.

The transport hubs methodology has been improved along with approaches as for the hubs construction which differs from the present ones in the complex vision of passenger transportation by several transport means simultaneously and corresponding transfers. The latter allows to shorten time term of trips and make them more comfortable for a single ticket.

3. Methodology

At present there exist no scientific approach in Ukraine as for the construction of hubs and definition of their main functions. Now to solve this problem general methodology of passenger transportation is in practice, which does not take into account additional functions of railway stations connected with improvement of schedules of several transport means taken simultaneously along with transfers. As the problem under research concerns interaction of railways with other transport means and transfer transportation, the authors use the systematic approach that makes it possible to determine all the necessary functions which railway hubs must perform.

4. Findings

Currently, railway stations in Ukraine - future HUBs perform the following functions (Fig. 1):

- The transfer of passengers from one direction of travel to another is the main function. Now it is executed by Ukrzaliznytsya, but it is not completely optimized and needs to be improved;
- Transfer of passengers from long-distance passenger transport modes to high-speed and commuter trains and in opposite direction. This function is now also being implemented, but an additional linking of the schedules of the specified trains is needed, which requires a reduction in the total passenger travel time;
- Transfer of passengers from railway trains to all possible types of local transport (metro, tram, trolleybus, bus) for transportation to their homes or other local stations. This function is now performed by local authorities.

If you study foreign experience, then you can determine the additional functions of railway HUBs (Fig. 1):

- Providing shopping, entertainment and information services for convenient accommodation of passengers whilst waiting for the following modes of transport;
- Organization of transfers of passengers for their further travel by other means of transport (buses, airplanes, river and sea vessels, etc.);
- Organization of transfers of baggage of the passengers for their further travel by other means of transport (buses, planes, river and sea vessels, etc.);

- Providing passengers with single ticket travel services for different types of transport.

It is possible to further increase the list of functions and services that can be provided by railway HUBs, but first they need to be economically substantiated

The most important function of HUBs is the optimization of the traffic schedule between the passenger trains of various types of communication to shorten the length of stay of passengers at railway stations whilst waiting for other trains and transfers. How to understand the optimization of the schedule of passenger trains? Suburban trains must arrive at the train station (HUB) in advance of the arrival of a passenger or high-speed train, taking into account their delay. In this case, it is possible to introduce on the railways for the convenience of passengers a single ticket, which will allow them to travel by two types of trains. All these measures will allow passengers to reduce the total travel time only by rail.

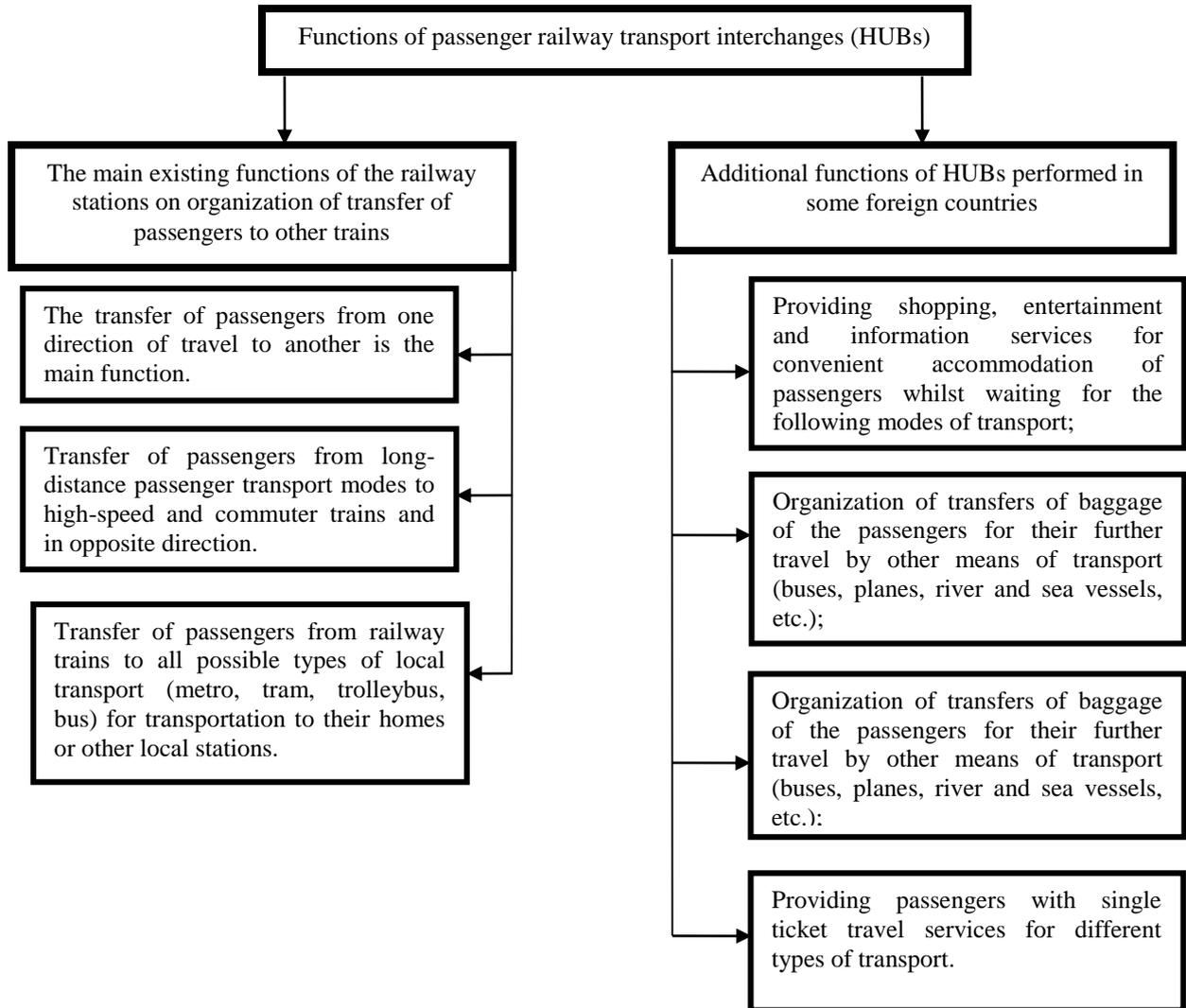


Fig. 1 Possible functions of passenger rail transport interchanges (HUBs)

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There are many cases when a passenger travels a complex route, for example, from a small town in the Dnipropetrovsk region by a suburban train to Dnipro, and then by a high-speed train to Kiev, then by bus to Boryspil airport, and from there on an airplane to spend vacation in any country. This complex journey requires a lot of effort from the passenger, while the presence of children and suitcase creates a lot of problems.

If we introduce additional functions at the Dnipro station, namely, link the schedule of the suburban and high-speed trains and organize a single ticket trip, which will also include the cost of a shuttle to Boryspil Airport, it will significantly reduce the passengers' travel time and improve the quality of the services provided to them.

By the way, now in Ukraine, some travel companies use transfer services to transport tourists from some cities to major transport points (airports, railways, river and sea ports). The price of such a transfer is included in the cost of the tour. In view of the above, it is possible to add the organization of transfers of passengers for their further travel by other modes of transport (buses, airplanes, river and sea vessels, etc.) to the main functions of the railway HUB.

Railway HUBs can also use an additional service that is currently used by Ukrainian airports for arranging transfers of baggage for their further travel by other modes of transport (buses, airplanes, river and sea vessels, etc.). This will allow passengers to have only the necessary things with them, and spend free time before traveling at their pleasure. For this purpose it is advisable to provide shopping and entertainment services at railway stations.

One can give an example, as in Hungary, the functions of HUBs are used at the Kispest (Budapest) railway junction. The station serves the transportation of passengers in the long-distance, high-speed and suburban traffic. Near across the land crossing there is a bus station, a subway, a tram, a taxi and a large shopping and entertainment centre. All this together is a compact and very comfortable HUB.

5. Practical value

The implementation of the new functions of the transport interchange points will allow the management of PJSC "Ukrainian Railways" to create additional amenities for passengers and improve the quality of their services by optimizing the train schedule, reducing the travel period, providing additional transfers for passengers and baggage, as well as shopping and entertainment services.

Conclusions

On the basis of the above studies, the following conclusions can be drawn:

1. Organization of HUBs on the basis of large railway stations of Ukraine is expedient and necessary, as it will reduce the total travel time of passengers and significantly improve the quality of their services. At the same time, this will increase the efficiency of the use of rail transport and generate additional revenue from the provision of new services.

2. Each city should take into account the existing features of the construction of the transport infrastructure, to customize the organization of HUBs and use only some of the proposed functions.

References

1. Materials of the V International Scientific and Practical Conference "Marketing and Logistics in the Rail Transport Management System Mil-2015". 2015, Kamyranets-Podilskyi city. LLC "Sprint-Service".
2. Materials of the X Anniversary International Scientific and Practical Conference "Problems of Economics and Management in the Railroad Transportation of the CCEU-CCEU-2016". - Kyiv, 2016.
3. Materials of the IV International scientific and practical conference "Marketing and logistics in the system of management on the railway transport. 2016, Zaporozhye
4. Kreutzberger E, Konings R. The challenge of appropriate hub terminal and hub-and-spoke network development for seaports and intermodal rail transport in Europe. *Research in Transportation Business &*

Management 2016; 19: 83-96. DOI : <https://doi.org/10.1016/j.rtbm.2016.05.003>.

5. Bartosik M, Wiak S. Multi-annual Program “By Railway to the 21st Century” as Key Factor in the Development of Rail Transport in Poland. *Transportation Research Procedia* 2016; 14: 518-527. DOI: <https://doi.org/10.1016/j.trpro.2016.05.107>

6. Rau H, Hynes M, Heisserer B. Transport policy and governance in turbulent times: Evidence from Ireland. *Case Studies on Transport Policy* 2016; 4: 45-56. DOI: <https://doi.org/10.1016/j.cstp.2015.11.006>

7. Yatskiv I., Budilovich E. A comprehensive analysis of the planned multimodal public transportation HUB. *Transportation Research Procedia* 2017; 24: 50-57. DOI: <https://doi.org/10.1016/j.trpro.2017.05.067>.

8. Zhu Y, Hu C, Xu D, Tang J. Research on Optimization for Passenger Streamline of Hub. *Procedia - Social and Behavioral Sciences* 2014; 138: 776-782. DOI: <https://doi.org/10.1016/j.sbspro.2014.07.258>.

9. Motraghi A. Rail research projects: Case studies. *Research in Transportation Economics* 2013; 41: 76-83. DOI: <https://doi.org/10.1016/j.retrec.2012.10.001>

10. Hisham E. Sustainable development criteria set for the transportation hubs of the national association of provinces planning. *Procedia Engineering* 2011; 21: 1042-1055. DOI: <https://doi.org/10.1016/j.proeng.2011.11.2110>.