вания в районе тяготения любых видов сообщения.

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# FEASIBILITY ASSESSMENT OF DEVELOPMENT OF PASSENGER SERVICE LOGISTIC SYSTEMS

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## ABSTRACT

Recent studies show that there is still no clear universal system to assess feasibility of forming a logistics chain of passenger service, which would take into account not only the interests of each individual mode of transport or passenger traffic segment, but would consider the whole transport system of load area (country, region, metropolis, etc.). Approaches to solving this problem are demonstrated by the authors, using analytical methods and logistics characteristics of transport, its consumer properties, reflecting value of a transport product for a passenger and technical and technological capabilities of each carrier.

*Keywords: transport, logistics, passenger transportation, evaluation system, logistic principles, indicators of functioning, choice of routes, gravity area.*

***Background.*** *Theoretical research and practice of passenger transportation organization on the basis of logistics principles (mainly foreign experience) indicate that logistics confidently becomes a basis of public transport services in all types of traffic: long- distance, suburban, suburban-urban and inner city. But another aspect is equally obvious: more often there is no clear universal system to assess the feasibility of forming a logistic chain of passenger services, taking into account not only the interests of each mode of vehicle or passenger traffic segment, but in general traffic situation in the area of gravity of communication lines.*

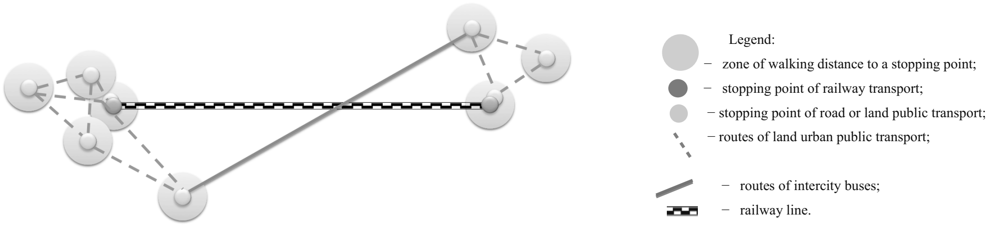
***Objective.*** *The objective of the authors is to investigate system of feasibility assessment, which is applicable to formation of logistics systems.*

***Methods.*** *The authors use analytical method, comparative method, evaluation approach.*

***Results.*** *System of feasibility estimation is designed to determine a possibility of participating in transportation provision of the area of gravity of a particular mode of transport, to set priorities in their use and to consider changes in technology or operational parameters to know the extent of innovation impact on transport efficiency. In addition, the system should allow flexibility to vary transport and logistics solutions for correction of parameters and to re-evaluate guidelines of logistics services.*

*Let's suppose that shaping out of logistics chains of passenger traffic development is more correct taking into account «peak» and «off-peak» periods of work schedule. Irregularity of transportation is determined by the serviced segment: for long-distance passenger routes the most characteristic are summer «peaks» or seasonal fluctuations, for commuter – diurnal fluctuations and fluctuations by weekdays.*

*For example, in formation of logistics systems in suburban, suburban-urban and intercity transportation in «peak» periods the preference should be given to modes of transport with a greater carrying capacity, while in periods of the day with a small number of passengers, attention should be switched to reduce intervals in traffic. In addition, we cannot ignore social factors, provision of*




***Pic. 1. An example of the route network of transport modes, on the basis of which it is possible to form a logistics system for development of passenger traffic.***

*integrated security, environmental protection, etc. One of the variants of the route network of modes of transport and logistics system formation for development of passenger traffic is shown in Pic. 1.*

*The need or possibility of forming logistic chains of passenger transportation in each period on a particular route when there are multiple modes of transport, serving it, is determined by total expediency (via coefficient N) of their use on certain sections of the line in comparison with the options of a separate service of the entire route by each mode of transport:*

$$\tilde{N} = \sum_{i=1}^{n} k_i \bullet \frac{L_i}{L_M},$$

*where $k_i$ is feasibility coefficient of the use of the i-th mode of transport per unit length of a considered route;*

*$L_i$ is length of a route part, which is supposed to be served by the i-th mode of transport, km;*

*$L_M$ is total length of the route served, km;*

*n is a number of route sections, served by different modes of transport.*

*Part of the route served by a particular mode of transport is a distance between division points of sections, limited by transport interchange hubs (TIH), suggesting the presence of alternative modes of transport to serve the same segment of passenger traffic. Location of TIH should comply with sudden changes in the density of passenger traffic. The length of a walking path in the process of transport interchange may not exceed the values established by constructio rules and regulations.*

*Feasibility coefficient of the use of the mode of transport on route (section) is set according to the degree of development of its transport infrastructure, operational parameters, characteristics of vehicles and other resources to meet the needs of passengers for transport services. Thus, in turn, feasibility coefficient depends on importance of a number of logistic characteristics of its use, which must be defined in addition to operation indicators of each mode of transport.*

$$k_i = \sum_{j=1}^{m} k_j,$$

*where $k_j$ is coefficient of importance of the j-th indicator in the use of the i-th mode of transport on a route section ($0 \le k_j \le 1$);*

*m is a number of importance coefficients.*

*As logistic characteristic of transport may be considered its consumer properties, which reflect a certain value of a transport product for a passenger, as well as properties, which characterize technical and technological capabilities of each carrier:*

*– intensity of departure of vehicles;*

*– walking distance to transport infrastructure facilities;*

*– safety degree of transportation process;*

*– flexible transportation schedules;*

*– environmental friendliness of transport;*

*– possible capacity and carrying capacity;*

*– passenger capacity of vehicles on the route;*

*– operating costs (given to costs per transportation of one passenger), etc.*

*Coefficient of carrying capacity use determines resources of each mode of transport in development of forecasted passenger traffic on the route (section). Thus, if coefficient value for a mode of transport tends to 1, its possibilities have been exhausted, and further presence on the route requires strengthening, investment in transport infrastructure development for this type of transportation or acquisition of rolling stock with higher passenger capacity.*

*In case of underutilization of capacity / carrying capacity of a particular mode of transport it is necessary to increase the share of its participation in the logistics system using multiplying coefficients, to identify reasons for consumer unattractiveness and to take measures to increase competitiveness. Otherwise, the passenger traffic will be redistributed in created logistic scheme contrary to logistics routes, as passengers, being intelligent «load», can make their own decisions on changing movement channels. Studies show that unattractiveness of transport mode is often related to inconvenience of schedules; its inconsistency with schedules of vehicles of other carriers, so more flexible logistics will significantly increase customer interest in service of a transport company, which thinks about them.*

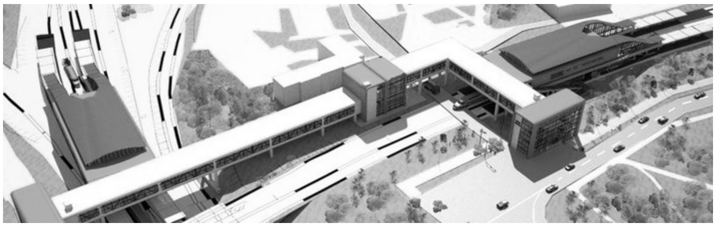
*Coefficient of passenger capacity use of a vehicle on the route is a ratio of proposed seat-kilometers to forecasted seat-kilometers. Ideally, it is equal to 1or with account of possible growth of actual passenger traffic in regard to forecasted – 0,95.*

*The intensity of departure of vehicles is determined by the ratio of the interval of their entrance to the route to the duration of the period under consideration. Thus, on the one hand, high intensity is maximum comfortable for passengers and timetables of division points, and on the other hand – increases the need for a number of vehicles and thereby directly influences operating costs. The interval between departures is given on the basis of ensuring a minimum passenger-hour waiting at main passenger-forming stopping points. The best performance is achieved if the interval of departure of vehicles coincides with the period of their turnover.*

*Walking distance of transport is regulated by typical rules of public transport service in urban and suburban traffic. In the city center pedestrian approaches distance should not exceed 250 m, in industrial and municipal storage areas – no more than 400 m, in areas of mass rest – no more than 800 m. Walking distance is measured not only by a range of approaches, but also by the presence of safe crossings, traffic lights, etc. on pedestrian routes.*

*Safety of transport characterizes a ratio of indentified number of cases of citizens' security violation to a total number of transported passengers during the considered period.*

*Environmental friendliness of transport is determined by the amount of harmful emissions and impact on*



***Pic.2. Design project of transport transfer hub "Ryazanskaya" in Moscow linking metro, railway and public urban routes (http://stroi.mos.ru/news/tpu-ryazanskaya-soedinit-metro-zheleznuu-dorogu-i-nazemnyi-transport).***

*environment per one transported passenger.*

*Flexibility of schedules of certain vehicles depends on possible harmonization of their schedule with other modes of transport. Metro has the highest degree of flexibility due to minimum intervals in the movement of trains. Adaptability of air flights schedules is minimal due to technological features of airport operation. With harmonization of arrival and departure of vehicles of various carriers it is necessary to be aware that the smaller is the total duration of the trip, the less should be time spent by a passenger in the point of interchange.*

*Operating costs related to organization of delivery of passengers by different carriers and modes of transport are calculated according to existing methods on the basis of data on forecasted passenger traffic. But in addition to operational (qualitative and quantitative) performance of each carrier now it is necessary to fully take into account the performance of transport and logistics system, which in case of customer focus are becoming increasingly significant.*

*These indicators of the passenger transport and logistics system functioning, in particular, are:*

*– saturation of the route with proposed places;*

*– intensity of route servicing;*

*– multimodality coefficient;*

*– passenger mobility in the logistics system (number of options for moving along the routes, divided by the total number of routes);*

*– coefficient of schedule consistency (interchange time, divided by the total length of the journey);*

*– reliability of the logistics system functioning according to its constituent modes of transport, type of vehicle, position in the system,*

*– interchange coefficient (total interchange time, divided by the total travel time);*

*– variability of the system by class of service.*

**Conclusions.** *Logistics transport system with indicators of its operation should be considered as a whole, a single complex, which aims to qualitative, complete and rapid satisfaction of transportation needs of the population. That is what determines whether valuation principles and criteria for the formation of transport services in the area of gravity of all types of communication is practical.*

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