International Journal of Intelligent Information Systems
2018; 7(6): 48-51
http://www.sciencepublishinggroup.com/j/ijiis
doi: 10.11648/j.ijiis.20180706.11
ISSN: 2328-7675 (Print); ISSN: 2328-7683 (Online)

Engineering Patterns of Changes in the Parameters of Functioning of Intercity Passenger Transportation System

Nizami Gyulyev[1], Dolia Kostiantyn[2], Dolia Olena[3]

[1]Department of Transport Systems and Logistics, Beketov O. M. National University of Urban Economy in Kharkiv, Kharkiv, Ukraine
[2]Department of GIS, Land and Real Estate Appraisal, Beketov O. M. National University of Urban Economy in Kharkiv, Kharkiv, Ukraine
[3]Department of Information Control System (ICS), Kharkiv National University of Radio Electronics, Kharkiv, Ukraine

Email address:
c.dolya@ukr.net (D. Kostiantyn), olena.dolya@ukr.net (D. Olena)

To cite this article:
Nizami Gyulyev, Dolia Kostiantyn, Dolia Olena. Engineering Patterns of Changes in the Parameters of Functioning of Intercity Passenger Transportation System. *International Journal of Intelligent Information Systems*. Vol. 7, No. 6, 2018, pp. 48-51.
doi: 10.11648/j.ijiis.20180706.11

Received: January 10, 2019; **Accepted**: February 11, 2019; **Published**: March 1, 2019

Abstract: It is proved that when changing the parameters of the distribution of passenger traffic between automobile and railway route networks, the quantitative mean values of the average length of the route and medium network range of the ride change by less than 0.01%, and the transfer ratio remains unchanged. It is determined that changing the speed of the ride is such a factor that does not affect the quantitative values of the number of movements in the network, the transfer ratio, the average distance of the trip. At the same time, the existence of a polynomial dependence of the average coefficient of passenger capacity use and the number of buses on the speed of route/network rides has been proved. The functions of redistribution of volumes of transportation in relation to any route of different types of transport, with a constant total number of movements, causes an increase in the number of transported passengers, the transport operation of the route network, the average coefficient of passenger capacity, the number of vehicles. This obtained the sequence and content of studies of rational parameters of the intercity passenger system, which can be used in similar formalization of the action of the mentioned system in the consideration of international route systems. At the same time, the transport systems of a number of countries may modularly constitute the general system of a territory that is combined according to any principle.

Keywords: Transport System, Intercity Passenger Transport Route, Basic Parameters of Transportation, Efficiency, Model

1. Introduction

The paper examined issues of studying the basis of intercity passenger transport routes. It is established that the system of intercity passenger route transportation is not isolated. This causes the influence of the environment on the quantitative indicators of the parameters of the functioning of these systems, which is due to the possibility of quantitative changes in the parameters entering the system. It was determined that the current state of scientific approaches does not fully take into account the interrelation of elements of the intercity passenger route system when calculating the basic parameters of the functioning of this system. It is proved that the issues of further development of scientific approaches regarding the features of accounting for the mutual influence of the quantitative characteristics of the elements of the system of intercity passenger route traffic is relevant and subject to study.

2. Theoretical Background

Modern scientific approaches to planning parameters of transport systems determine methods based on the consideration of passenger correspondence between the nodes of the transport network. The authors of the work [1] presented an approach to intelligent route planning in public transport systems. The approach focuses on the formal simulation of a semi-dynamic, intelligent planning and route optimization. To this end, it is important to have a well-developed formal model that covers cosmic aspects in real time. The proposed solution allows developers to expand the public transport system with additional routes that are dynamically generated based on requests from passengers.

The model can be used within the framework of a sustainable city for both (fully or partially) autonomous transport systems and decision support systems of smart transport systems. In the work [2], vertical bus routes were developed, which reach the system of railway stations, as well as bus lines that have connection with the city center, turning into regional bus lines. The authors of the work [3] addressed the issue of route planning for public transport systems and proposed the presentation of a multi-modal transport network using a multi-criteria routing algorithm for modeling. In the work of the authors [4] the model of the probabilistic process of the bus service is defined. The authors of the work [5] have determined that the choice of a route by a multitude of passengers plays a primary role in estimating flows and forecasting demand. In the works [6-7], the question of determining the time of the provision of transport services depending on the location of stopping points was considered. The authors in their work [8-10] revealed the issues of estimating the number of transported passengers by the public transport system taking into account the behavioral model of people and their influence on the choice of mode of transportation. The authors of the work [11-13] determined the parameters for optimizing the transit railway route and the bus routes of the transit corridor. The result of the study is the definition of a multipurpose model that maximizes the rail transit passenger traffic and minimizes the total time of the passenger transit route.

3. Materials and Experiments

According to the one considered in the work, the process of redistributing passenger correspondences takes place between passenger route systems. It has been determined that the quantitative indicators of this redistribution (the choice of a passenger network) are influenced by a set of characteristics of alternative route networks. It can be assumed that with the redistribution of passenger transport correspondences, fluctuations in the actual values of quantitative indicators of basic indicators of the functioning of the route networks themselves occur. To determine the patterns of changes in certain parameters from the redistribution of passenger transport correspondence between the networks, appropriate calculations have been carried out for a set of options for a certain redistribution of passenger traffic between the automobile and railway networks. Dependence 1 proposed to be used to determine the function of redistribution of passenger traffic by type of transport (FP):

$$FP = \frac{\tau_{»ser»}\, k_{\tau} PR_{»ser»}\, k_{PR}(IFL)_{»ser»}\, I_Z k_{IFL} \sum_{Zm=1}^{Z} PM_{Zv}}{\tau_Z PR_Z (IFL)'_Z I_Z PM_{Zv}} \tag{1}$$

Where: PM_{zv} – number of passenger seats on routes of type of transport V;

Iz – the intensity of the vehicles movement on the Z route;

k_{PR}, k_{IFL}, k_{τ} – respectively, coefficients that take into account the weight of the corresponding parameter;

τ_z та τ_{ser} – respectively, time of movement at Z route and the average travel time on alternative routes;

PR_z та PR_{ser} – respectively, the price for the movement at Z route and the average price for alternative routes;

IFL_z and IFL_{ser} IFLz and IFLcer measure both the level of passenger fatigue on route Z and the average level of fatigue on alternative routes (interpreted by the passenger capacity).

Based on the results of calculations, the basic indicators of the functioning of the networks for the next set of passenger traffic distribution are obtained, namely: 15/85%, 20/80%, 25/75%, 30/70%, 35/65% and 40/60%. The results of calculations are summarized in Tables 1 and 2.

Table 1. *Basic performance indicators of the automobile route network with maintenance of 15%, 20%, 25%, 30%, 35% and 40% of the total passenger traffic – FP.*

Basic performance indicator	**The value of the function of redistribution of passenger transportation volumes on the automobile type of transport (FP)**					
	15%	**20%**	**25%**	**30%**	**35%**	**40%**
Number of movements – $P_{aut.}$, units	6047	8062	10078	12093	14108	16124
Volume of transportation $Q_{aut.}$, thousand pass	7053,4	9404,12	11755,67	14105,64	16455,35	18807,93
Transfer ratio – kпер	1,17	1,17	1,17	1,17	1,17	1,17
Transport work $W_{aut\cdot}$, pass./km	2770004	3692887	4616470	5538887,5	6462134	7385649,5
Average distance of a trip – $l_{ser.м.aut.}$, km	415,06	415,03	415,05	415,02	415,05	415,03
Average distance of a network trip – $l_{ser\cdot net.aut.}$, km	458,08	458,06	458,07	458,02	458,05	458,05
Medium system coefficient of passenger capacity use – $k_{sal.net.aut.}$)	0,24	0,27	0,29	0,3	0,31	0,32
Required number of buses – $A_{aut.}$,q=40	183	220	256	294	327	364

Table 2. *The basic performance indicators of the railway route network when servicing of 85%, 80%, 75%, 70%, 65% and 60% of the total passenger traffic – FP.*

Basic performance indicator	**The value of the function of redistribution of passenger transportation volumes on the rail type of transport (FP)**					
	85%	**80%**	**75%**	**70%**	**65%**	**60%**
Number of movements – $P_{jd.}$, units.	34263,01	32248,01	30233	28216,98	26201,99	24185,98
Volume of transportation $Q_{aut.}$, thousand pass.	41410,21	38973,31	36540,76	34102,85	31667,98	29229,2
Transfer ratio – $k_{per.}$	1,21	1,21	1,21	1,21	1,21	1,21
Transport work $W_{jd.}$, pass./km.	19526466	18378516	17230562	16082059	14933121	13783906
Average distance of a trip – $l_{ser.net.jd.}$, km	526,72	526,75	526,74	526,77	526,75	526,75

Basic performance indicator	**The value of the function of redistribution of passenger transportation volumes on the rail type of transport (FP)**					
	85%	**80%**	**75%**	**70%**	**65%**	**60%**
Average distance of a network trip – $l_{ser.net.jd.}$, km	569,9	569,91	569,93	569,94	569,92	569,91
Medium system coefficient of passenger capacity use – $k_{sal.net.jd.}$)	0,38	0,38	0,37	0,37	0,37	0,37
Required number of buses – $A_{vag.}$,q=40	900	845	801	747	702	653

4. Results

Based on the results of the calculations performed using the quantitative values of the calculated basic indicators of the functioning of the networks for the distribution of FP between the automobile and railway networks, it was possible to construct graphs for changes in certain parameters. Figure 1 shows a graph of changes in the number of movements in the automobile route network when changing the FP distribution between automobile and rail network.

$$P\_aut = 0{,}7937 + 403{,}0742FP \tag{2}$$

Let us construct the function (2) of the response for $P_{aut.}$ – the number of movements by automobile routes.

Where: $P_{aut.}$ – number of movements by automobile routes;

FP – the value of the function of redistribution of passenger transportation volumes on a rail type of transport.

Let us carry out calculations on dependence (2) and compare the results obtained with the baseline data. The calculation results are summarized in Table 3.

Table 3. *Results of calculation $P_{\text{авт}}$ – the number of movements by road routes according to the dependence (2).*

$P_{aut.}$ units	**$P`_{aut.}$ calculated, units**	**Deviation between $\lvert P`_{aut.}\rvert$ and $\lvert P_{aut.}\rvert$, %**
6046	6047	0%
8062	8062	0%
10077	10078.01	0%
12093	12093	0%
14108	14108	0%
16123	16124	0%
	Total:	0%

According to the obtained results it can be stated that it is possible to predict $P_{aut.}$ – the number of movements by automobile routes in accordance with the proposed dependence (2) with a definite deviation.

Figure 2 shows a graph of the change in $P_{jd.}$ – the number of rail route movements when changing the FP distribution between automobile and rail network routes.

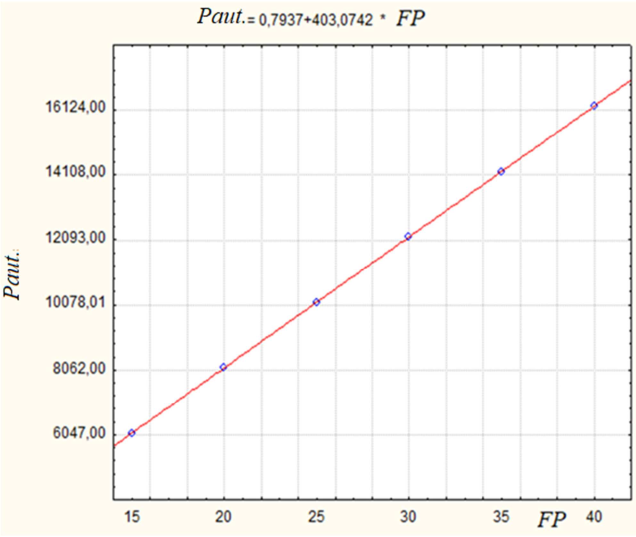

Figure 1. *T^{tp} changes over time during the day on a weekday, for routes optimized by T^{tp} and l_p.*

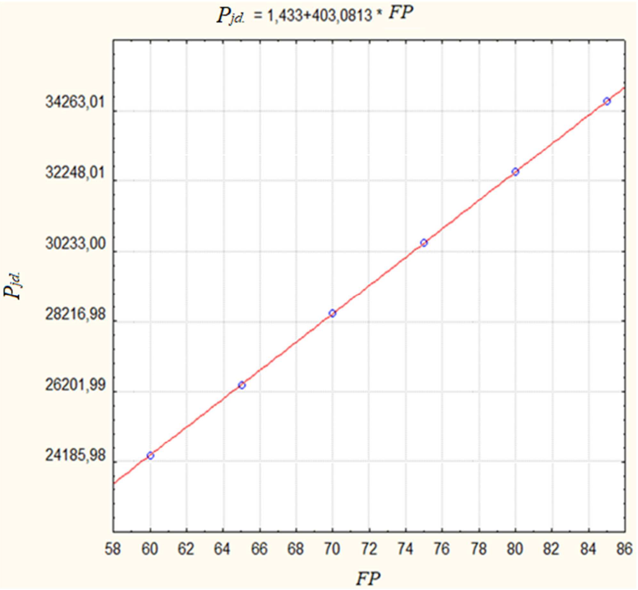

Figure 2. *Graph of the change in $P_{jd.}$ – the number of movements by the rail network when the FP distribution between the road and railway routes is changed.*

$$P_{jd.} = 1{,}433 + 403{,}0813FP \tag{3}$$

Let us carry out calculations on the dependence (3) and compare the results obtained with the baseline data. The calculation results are summarized in Table 4.

Table 4. *results of calculating the number of movements by automobile routes according to the dependence (3).*

$P_{jd.}$. units	**$P`_{jd.}$ calculated, units**	**Deviation between $\lvert P`_{jd.}\rvert$ and $\lvert P_{jd.}\rvert$, %**
34263	34263	0%
32247	32248	0%
30232	30233	0%
28217	28216	0%
26201	26201	0%
24186	24185	0%
	Total:	0%

According to the obtained results of the comparison of the basic indicators of the $P_{jd.}$ – the number of rail network movements with the values determined by the results of calculations of the same value according to the dependence (3), the parameters of such a deviation are established.

5. Conclusion

Increasing the function of redistribution of volumes of transportation in relation to any route of different types of transport, with a constant total number of movements, causes an increase in the number of transported passengers, transport operation of the route network, the average carrying capacity, the number of vehicles. The regularities of changing the basic indicators of the operation of the intercity passenger routes from the proposed function of redistribution of traffic volumes, connection speed and passenger capacity utilization coefficient are determined. The function of redistribution of passenger traffic volumes by types of transport ensures that the total number of passenger seats in the route network of the corresponding type of transport is taken into account when calculating the redistribution of passenger transportation volumes by type of transport.

References

[1] Kostiantyn, D. (2017). Influence of the Seasonal Factor on the Long-Distance Passenger Correspondence. American Journal of Data Mining and Knowledge Discovery, 2 (4), 96-101.

[2] Dolya, C., Lyfenko, S., Nesterenko, S., & Vyatkin, K. (2017). Influence of features of the transport network pattern on the haul cycle length between its nodes on the example of the transport network of Ukraine. Technology audit and production reserves, 5 (2 (37)), 54-58.

[3] Dolya, C. V. (2017). Gravity Model Formalization for Parameter Calculation of Intercity Passenger Transport Correspondence. SCIENCE & TECHNIQUE, 16 (5), 437-443.

[4] Dolia, K., Davidich, Y., Dolia, O., Lyfenko, S., & Uhodnikova, O. (2017). Modeling of polygons of maximum passenger route transport accessibility by the example of the transport system of Ukraine. Technology audit and production reserves, 6 (2 (38)), 28-33.

[5] Kostiantyn, D. (2017). Variativity of the Transport System at Intercity Passenger Transport from the Demand. International Journal of Data Science and Analysis, 3 (6), 77.

[6] Dolya, C., Lyfenko, S., Nesterenko, S., & Vyatkin, K. (2017). Influence of features of the transport network pattern on the haul cycle length between its nodes on the example of the transport network of Ukraine. Technology audit and production reserves, 5 (2 (37)), 54-58.

[7] Dolya, C., Botsman, A., & Kozhyna, V. (2017). Investigation of approaches to modeling of intercity passenger transportation system. Technology audit and production reserves, 4 (2 (36)), 24-28.

[8] Dolya, C. (2017). Modeling of intercity passenger transportation system. Technology audit and production reserves, (2 (2)), 37-43.

[9] Grigorova T., DavIdIch Yu., Dolya V. (2015). Assessment of elasticity of demand for services of suburban road passenger transport. Technology audit and production reserves. 3. 2 (23). 13–16.

[10] Dolya, C. (2017). Modeling of passenger transport correspondence between regional centers in Ukraine. Technology audit and production reserves, 1 (2 (33)), 44-48.

[11] Galkin, A., Dolia, C., & Davidich, N. (2017). The Role of Consumers in Logistics Systems. Transportation Research Procedia, 27, 1187-1194.

[12] Skrypin, V., Galkin, A., Kush, Y., & Dolia, V. (2016). Influence of international transport corridors on transportation service. Logistyka, (3), 56-64.

[13] Dolia, V., Kush, Y., & Galkin, A. (2014). Several logistics chains transportation services approach by single transport company. Journal L'Association 1901 SEPIKE, 4, 86-90.