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INFLUENCE OF ECONOMIC AND POLITICAL FACTORS ON THE PUBLIC RAIL TRANSPORT

The goal of the paper is to assess the territorial development in terms of the public rail transport in conditions of the Czech Republic or, more precisely, in the south of Bohemia. The capacity utilisation of the railway line No. 190 in the direction from Ceske Budejovice to the target station of Strakonice is analysed and the suitable deployment of the set of wagons, intended to be used in providing the basic transport services in the low-populated areas, is evaluated. The paper is concerned with the current situation in utilising the capacities on the railway line No. 190 with respect to the future utilisation of the railway links that will be affected by economic factors in the form of the reduced fare for students and pensioners. To this end, the mathematical and statistical methods, which will pre-define the suitability of the choice of capacities of the set of wagons in providing the basic transport services, will be applied.

Keywords: *public tramsport, the railway links, territory development, expected mean value*

1. Introduction

Principles of the territorial development define the spatial planning documentation for the whole regional territory, while refining and developing the objectives and tasks of the spatial planning in accordance with the territorial development policy. The strategies for achieving these goals are being determined and the planning activities of individual municipalities or towns are being coordinated, [1].

The essential part of the territorial development is to submit the future plans for the construction of a new railway corridor and restoration of other railway lines which will intersect the chosen regions and have a significant influence on building other partial structures. The economic and political factors directly affect future decision-making and have an influence on the investment matters in the process of creating and establishing the living standard of individual citizens, [2-4].

The issue of the low-populated areas is currently being analysed from the viewpoint of providing the transport services by means of the public line transport and the public rail transport. The goal is to interconnect individual modes of transport in order to provide a sufficient transport capacity by means of individual linksinr the current economic, political and living conditions. The preferences of citizens (consumers, passengers) mostly provide, in the form of questionnaires, complaints or other forms of information, the suggestions, which become the subject of the decision making on investments and the future changes in the territorial development. The public transport, as a competitor to a private motor vehicles transport, is being addressed most frequently. The goal is to reduce the volume of the private motor vehicle transport and to support the public line and rail transports due to their environmental friendliness and the related financial savings of citizens, [5].

The economic situation in the Czech Republic has been positive in recent two years. The investment opportunities in the form of building the transport infrastructure (roads, railways, etc.) are on the rise. The economic development and the general life satisfaction increase, [6-8].

Citizens prefer innovation in the quality of the rendered public transport services. They require more frequent providing of the basic transport services in the low-populated areas in more frequent time intervals. The reason is also the problem of an insufficient number of parking places for passenger cars, especially in bigger towns. In Spain, for instance, the high-speed railway corridors are being built and developed to save the passengers´s time and to reduce the mental costs. [9-11].

The paper also deals with the issue of the public rail transport as the offering of the transport services with the expected number of the railway links and the transport capacity being provided.

The mathematical and statistical methods, which evaluate the suitability of the choice of variants being considered in the decision-making under risk in the public rail transport have been applied within the data analysis. The data are taken from the carrier´s internal database. The chosen methods serve for identifying the key factors that are adapted to the issue in question. The analyses have been made for the railway line No. 190, which has provided the current results and expectations for the future volume of passengers travelling in the Ceske Budejovice - Strakonice section[1]. The data contain the number of passengers transported within providing the basic transport services on working days in the low-populated areas per a specific period of time (July 2018).

The following two basic approaches have been chosen in the decision-making under risk:

- Rule of the expected mean value,
- Rule of the expected mean value and variance.

In determining the subjective probabilities allocated to individual random phenomena, the relative size method was chosen. This method works on the principle of the limited number

1 by RegioPanter 650, Locomotive 240+Bdt+BDs

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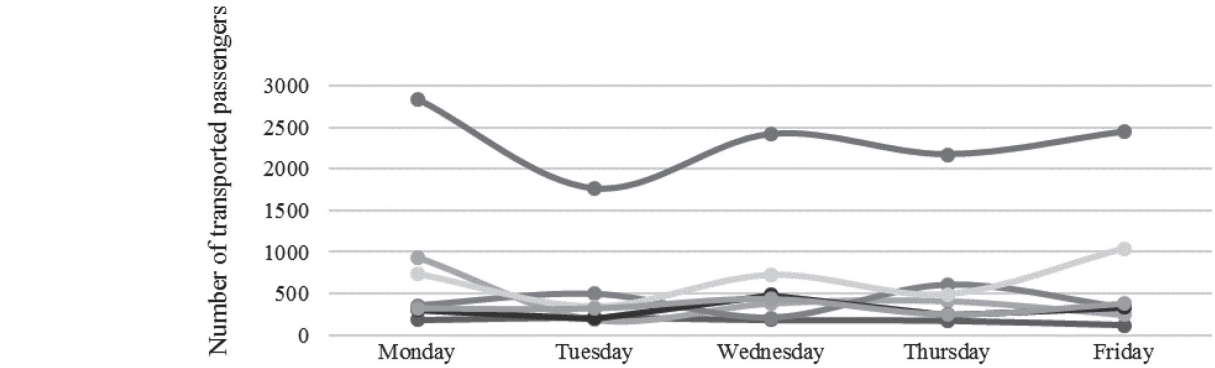

	Monday	Tuesday	Wednesday	Thursday	Friday
04:55 - 06:00	182	215	182	173	116
06:16 - 07:22	937	187	382	410	245
07:30 - 08:35	357	499	207	611	330
10:18 - 11:20	306	197	482	240	332
12:18 - 13:20	732	340	718	489	1037
14:30 - 15:32	322	323	442	248	383
Total number of passengers transported	2836	1761	2413	2171	2443

Figure 1 *Evaluation of individual railway links on the railway line No. 190 (Ceske Budejovice - Strakonice)*

Table 1 *Capacity utilisation and number of passengers transported on the railway line No. 190*

Time of railway link	Monday	Tuesday	Wednesday	Thursday	Friday	Number of passengers transported as per railway links
04:55 AM - 06:00 PM	182	215	182	173	116	868
06:16 AM - 07:22 AM	937	187	382	410	245	2161
07:30 AM - 08:35 AM	357	499	207	611	330	2004
10:18 AM - 11:20 AM	306	197	482	240	332	1557
12:18 PM - 13:20 PM	732	340	718	489	1037	3316
14:30 PM - 15:32 PM	322	323	442	248	383	1718
Total number of passengers transported	2836	1761	2413	2171	2443	
	The highest volume of passengers transported on a working day					

of random phenomena on condition that individual probabilities of random phenomena equal to one, as follows

$$probability = p_1 + p_2 + p_3 + \cdots + p_n = 1 \quad (1)$$

The rule of the expected mean value E(x) is determined according to the following formula:

$$expected\ mean\ value = \sum_{i=1}^{n} xi * pi \quad (2)$$

If the maximizing criterion applies to the entering table, the variant containing the greatest value will be optimal. In case of the minimizing criterion, on the other hand, the variant with the lowest value is taken into account.

The rule of the expected mean value and variance D(x) is determined according to the following formula:

$$variance = \sum_{i=1}^{n} [xi - E(x)]^2 * pi \quad (3)$$

The variant is chosen based on the lowest variance value [12-13].

The input data and the calculation are shown in the results.

2. Results

The data provided by Ceske drahy, a.s. for the South Bohemian Region have been analysed.

Table 2 *Expected number of transported passengers after the application of the decision-making theory method of risk*

Choice of a suitable capacity/ expected number of passengers transported within 1 working day by means of 6 railway links	Maximizing criterion				
	1000	1500	2000	2500	3000
150 (900)	-21150	-21150	-21150	-21150	-21150
200 (1200)	-18540	-9720	-9720	-9720	-9720
250 (1500)	-20340	1710	1710	1710	1710
300 (1800)	-22140	-90	13140	13140	13140
350 (2100)	-23940	-1890	20160	24570	24570
400 (2400)	-25740	-3690	18360	36000	36000
450 (2700)	-27540	-5490	16560	38610	47430
Probability of a random phenomenon	0.6	0.2	0.1	0.05	0.05

Table 3 *Results of the method of expected mean value and variance*

Rule of the expected mean value	EX		
150 (900)	-21150		
200 (1200)	-15012		
250 (1500)	-11520		
300 (1800)	-10674		
350 (2100)	-10269	Appropriate to deploy the InterPanter with five wagons	
400 (2400)	-10746		
450 (2700)	-11664		
Rule of the expected mean value and variance	Variance	Standard deviation	
150 (900)	0	0	Appropriate to deploy RegioPanter
200 (1200)	18670176	4320.89991	
250 (1500)	116688600	10802.2498	
300 (1800)	214707024	14652.8845	
350 (2100)	340147269	18443.0819	
400 (2400)	448084224	21168	
450 (2700)	539490294	23226.9304	

Figure 1 shows the average numbers of passengers transported in July 2018 on working days by means of six railway links. Railway links on the railway line No. 190 represent the complete offering of passenger trains. Fast trains and express trains, which do not serve the low-populated areas, were not included. The above Table shows individual railway links and the number of passengers transported by them in selected time intervals, as well as the total evaluation.

Overall, Monday is the busiest working day with a total number of 2836 passengers. The busiest railway link on working days is the train departing from Ceske Budejovice at 12:18 and arriving at Strakonice at 13:20, see Table 1.

In July 2018, the average number of transported passengers was 11624. Monday was the busiest working day. Taken in an ascending order, the order is as follows: Monday, Friday, Wednesday, Thursday and Tuesday.

The government and the Ministry of Transport of the Czech Republic have decided on the grant of discounts for students and the persons above 65 years of age. The above groups of passengers will pay 25 % of the fare only. The remaining 75 % will be compensated to the carriers from public budgets (of the state, municipalities or towns/cities). The prerequisite for the grant of discounts for students is that the students must hold a valid ISIC card (full-time study) and the passengers below 15 must be holders of the pupil´s ID card. The decision on the grant of discounts became effective in September 2018. Table 2 assumes the random phenomena (number of passengers in certain values), options of the set of wagons deployment as per the provided capacities and stating of subjective probabilities for individual random phenomena based on of the relative size method. The random phenomenon (1000 passengers) becomes the most probable consideration with a probability of 60 %.

The following data upon which the entering table will be set are under consideration. Considering the following structure of passengers:

a) 60 % students (pupils) and passengers above 65, who pays 25 % of the fare,
b) 10 % passengers - reduced fare - 25 %,
b) 10 % passengers - reduced fare - 50%,
d) 20 % passengers paying the full fare.

Structure of sales from passengers transported on the railway line No. 190 (Ceske Budejovice - Strakonice):

a) Students (full-time study) and pupils, pensioners: CZK 23[2],
b) Passengers entitled to a reduced fare (25 %): CZK 70,
b) Passengers entitled to a reduced fare (50 %): CZK 47,
d) Passengers paying the full fare: CZK 93.

Based on the economically substantiated costs, the costs per one travelled kilometre, in the case of passenger trains, are as follows as per the type of the set of wagons deployed and the allowable capacity:

1) Capacity of 150 places: CZK 169 per train-kilometre
2) Capacity of 200 places: CZK 174 per train-kilometre
3) Capacity of 250 places: CZK 179 per train-kilometre
4) Capacity of 300 places: CZK 184 per train-kilometre
5) Capacity of 350 places: CZK 189 per train-kilometre
6) Capacity of 400 places: CZK 194 per train-kilometre
7) Capacity of 450 places: CZK 199 per train-kilometre.

The total number of travelled train-kilometres according to the timetable amounts to 60 train-kilometres. The total capacity of 6 railway links is set. The train (wagon) turnover is not considered. All values have been taken from the primary reports on costs and sales from transport operations in the public rail transport.

The Table 3 inputs contain the negative values. This is why the revenues from passenger transport fail to sufficiently cover the operating costs of selected railway links. If the rule of the expected mean value is applied, the variants will have negative values. It means that the economic result is expected to be always negative and not positive. From the loss minimization viewpoint, it is appropriate to choose the variant of the set of wagons with a capacity of 350 passengers within one railway link. With 6 railway links deployed, the total capacity is 2100 passengers.

The rule of the expected mean value and variance reviews the appropriate variant based on the assumption of remote distances from the expected mean value. The lowest value will represent the most advantageous variant. In this case, it is appropriate to choose the first variant, i.e. the deployment of the set of wagons with a capacity of 150 passengers within one railway link.

2 Exchange rate 1 EUR = 25.778 CZK (Czech National Bank)

3. Conclusion

Economically substantiated costs are always higher than the price of (revenue from) the fare in the South Bohemian Region. The reason is the lower number of transported passengers and the preference of the private motor vehicles transport. The public rail transport is, as a rule, in the red. The economic result is negative (loss). For the future providing of the basic transport services by the public rail transport, it is necessary to compensate the loss with the financial means from public budgets. This implies that the economically substantiated costs are compensated (to zero) and the carrier will continue to obtain the compensation or an adequate profit, which is stipulated in the public service contract. The data have been analysed for the period of July 2018 when the students and the persons above 65 were not granted a discount of 75 % off the regular fare. The results show that a total number of passengers transported by means of the six railway links on the line No. 190 (Ceske Budejovice - Strakonice) amounted to 11624. The number of passengers is expected to considerably increase when the carrier offers a reduced fare (75 %). The goal is to prefer the public transport over the private motor vehicles transport. The carriers strive to serve the low-populated areas, while innovating the provided services and coordinating the railway network. The results point to the possibilities of selection of chosen variants, which may be expected after applying the mathematical and statistical rules (approaches).

Another problematic area is the reduction of the value added tax rate (VAT) on fares, effective since February 2019. The VAT is the main source of income for funding the public transport. In the last months, the passengers were still paying the first reduced rate of VAT, i.e. 15 %. The Senate of the Czech Republic strives for the VAT rate reduction to 10 % of the fare within the amendment of the VAT Act. This will result in the further monetary outflow, i.e. the lack of income going into public budgets. The paper contains the assumptions of the considered changes, which will become the basis for drawing-up the next publication.

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