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EFFECTIVENESS OF THE USE OF PASSENGER RAIL TRANSPORT IN THE TERRITORY OF THE CZECH REPUBLIC

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Abstract

Passenger transportation began to be used already in ancient times. Among the first necessary means of transport were the use of wooden transport carts in Mesopotamia and later the use of ships and sailing ships in Egypt. Subsequently, other types of transport began to develop gradually. Until today, the method of transporting people has been constantly transformed to its current form. The article deals with rail transport on the territory of the Czech Republic. Specifically, it is about determining the effectiveness of passenger rail transport for individual regions based on the analysis. The results will determine the most efficient and, at the same time, the least efficient use of rail transport for individual regions in the territory of the Czech Republic. Determining efficiency within this context is appropriate for the regions themselves and their solutions to the traffic situation in the future. Regions with lower efficiency in transport use should create suitable conditions for improving the given issue.

Keywords: Transport; Rail Transport; Effectiveness; Analysis

1. Introduction

Humanity uses various means of transport for faster transportation from one place to another [1]. One of them is rail transport [2]. The article deals with the effectiveness of the use of passenger rail transport in the territory of the Czech Republic. The article first describes transportation in general. Subsequently, rail transport in the Czech Republic is described. This part is followed by a chapter regarding the analysis of passenger rail transport in the Czech Republic, where individual coefficients are gradually evaluated to determine efficiency. The last chapter deals with the efficiency of passenger rail transport, where four groups are created according to the values of the coefficients.

The result of solving the traffic situation is not only the transportation of people or things from place A to place B. [3] It is also about the efficient use of transport. Among the effective methods of transport is the solution to the traffic situation so that there are no queues, that passengers do not have long downtimes, that all types of transport communication are used effectively, that the traffic of means of transport is accelerated and many other ways. [4] The result of solving the traffic situation is not only the transportation of people or things from place A to place B. It is also about the efficient use of transport. Among the effective methods of transport is the solution to the traffic situation so that there are no queues,

that passengers do not have long downtimes, that all types of transport communication are used effectively, that the traffic of means of transport is accelerated and many other ways.

2. Transport

Currently, transport is significantly developed [5]. Transport can be divided into four classifications. The first transport division is according to space, divided into land, water and air. Land transport can be road, rail and non-motorized (pedestrian and bicycle). Water transport is divided into inland, coastal and maritime. The second classification is according to the object and method of transport, which can be passenger or cargo. Personal transport can be divided into individual or collective. Freight transport is public or private. The third classification of traffic distribution is according to the territorial distribution of transport needs. This classification is divided into urban, local, national, regional or international. The last classification of the distribution of traffic is according to the relationship between the source and the traffic destinations concerning the given territory. This category includes internal, external or transit transport. [6]

Transport in the Czech Republic is primarily divided into road, rail, water and air. Road transport includes cars, buses, motorcycles, trolleybuses and bicycles. Rail transport includes trains, trams, subways or cable cars. In the Czech Republic, highways, roads for motor vehicles and other roads are designated for road transport travel. [7]

3. Railway transport in the Czech Republic

The railway network in the Czech Republic in 2022 consisted of 9,355 kilometres of state railway lines and over 100 kilometres of regional railway lines. The railway administration ensures the performance of the function of railway ownership. The structure of railway lines, according to the number of lines, is divided into single-track (7,287 km), double-track (2,003 km) and multi-track (65 km). The total length of electrified lines is 3,215 kilometres. There are 6,733 railway bridges with a length of over 156 kilometres and 169 tunnels with a length of fewer than 56 kilometres in the entire territory of the Czech Republic. There are 1,062 railway stations, and 1,546 railway stops in the Czech Republic as part of railway transport. [8] [9]

4. Analysis of passenger railway transport in the Czech Republic

This chapter consists of 4 parts, where the resulting coefficient is evaluated from each part, which serves to evaluate the efficiency of rail transport in the Czech Republic.

4.1 Number of passengers depending on the number of inhabitants

Specific values can be found in the following tables. Table 1 describes the number of passengers in the region based on the number of departures from the region, arrivals from the region and the number of passengers within the region (internal).

Region	Number of passengers (in thousands)			
	Departures	Arrivals	Internal	SUM
Prague	19 018	18 773	11 894	49 685
Central-Bohemian	12 593	12 758	6 528	31 878
South-Bohemian	1 466	1 467	4 008	6 941
Pilsen	1 587	1 630	7 280	10 497
Karlovy Vary	559	574	2 502	3 635
Usti nad Labem	1 659	1 714	7 931	11 303
Liberec	1 145	1 182	5 292	7 619
Hradec Kralove	2 077	2 160	6 036	10 273
Pardubice	3 372	3 303	5 455	12 130
Vysocina	1 086	1 134	2 399	4 619
South-Moravian	3 016	2 980	24 444	30 441
Olomouc	3 159	3 126	7 527	13 812
Moravian-Silesian	2 377	2 312	16 915	21 603
Zlin	1 517	1 517	3 915	6 949
SUM	54 630	54 630	112 125	221 384

Table 1. Number of passengers in regions [10, 11, modified]

The first coefficient (C_1) is determined based on the number of passengers per 1000 region inhabitants. The resulting coefficient value is based on the descending order of the number of passengers per 1000 inhabitants of the region. Specific values can be found in the following table.

Region	Population (in thousands)	Number of passengers per 1 000 inhabitants	C_1
Prague	1 275	39,0	1
Central-Bohemian	1 387	23,0	4
South-Bohemian	637	10,9	13
Pilsen	579	18,1	8
Karlovy Vary	253	14,4	10
Usti nad Labem	799	14,1	11
Liberec	438	17,4	9
Hradec Kralove	543	18,9	6
Pardubice	515	23,6	3
Vysocina	504	9,2	14
South-Moravian	1 185	25,7	2
Olomouc	635	21,8	5
Moravian-Silesian	1 178	18,3	7
Zlin	572	12,1	12
SUM	10 498	21,1	-

Table 2. First coefficient [10, modified]

4.2 Number of passengers depending on the size of the region

The second coefficient (C_2) is determined based on the region's number of passengers per 1 square kilometre. The resulting coefficient value is based on the descending order of the number of passengers per square kilometre of the region. Specific values can be found in the following table.

Region	Area (square kilometres)	Number of passengers per 1 square kilometre	C_2
Prague	496	100,13	1
Central-Bohemian	11 929	2,67	5
South-Bohemian	10 058	0,69	13
Pilsen	7 649	1,37	11
Karlovy Vary	3 310	1,10	12
Usti nad Labem	5 339	2,12	9
Liberec	3 163	2,41	7
Hradec Kralove	4 759	2,16	8
Pardubice	4 519	2,68	4
Vysocina	6 796	0,68	14
South-Moravian	7 188	4,24	2
Olomouc	5 272	2,62	6
Moravian-Silesian	5 431	3,98	3
Zlin	3 963	1,75	10
SUM	79 871	2,77	-

Table 3. Second coefficient [10, modified]

4.3 Number of passengers depending on the operation length of the railway line

The third coefficient (C_3) is determined based on the number of passengers per 1 km of line. The resulting value of the coefficient is based on the descending order of the number of passengers per 1 km of line. Specific values can be found in the following table.

Region	Length of railway line	Number of passengers per 1 kilometre of line	C_3
Prague	212	234	1
Central-Bohemian	1450	22	5

South-Bohemian	956	7	14
Pilsen	725	14	10
Karlovy Vary	443	8	12
Usti nad Labem	1079	10	11
Liberec	454	17	8
Hradec Kralove	667	15	9
Pardubice	581	21	6
Vysocina	577	8	13
South-Moravian	754	40	2
Olomouc	622	22	4
Moravian-Silesian	644	34	3
Zlin	357	19	7
SUM	9521	473,3	x

Table 4. Third coefficient [10, modified]

4.4 Area based on the operation length of the railway line

The fourth coefficient (C_4) is determined based on the number of square kilometres of the region and 1 kilometre of operational length of the railway line. The resulting coefficient value is based on the ascending order of the square kilometres per 1 kilometre of the operating length of the railway line. Specific values can be found in the following table.

Region	**Region area per 1 kilometre of line**	**C_4**
Prague	2,3	1
Central-Bohemian	8,2	7
South-Bohemian	10,5	11
Pilsen	10,5	12
Karlovy Vary	7,5	5
Usti nad Labem	4,9	2
Liberec	7,0	3
Hradec Kralove	7,1	4
Pardubice	7,8	6
Vysocina	11,8	14
South-Moravian	9,5	10
Olomouc	8,5	9
Moravian-Silesian	8,4	8
Zlin	11,1	13
SUM	115,2	x

Table 5. Fourth coefficient [10, modified]

5. Efficiency of passenger railway transport in the Czech Republic

The efficiency of railway transport in the Czech Republic is determined for each region of the Czech Republic separately. The resulting efficiency is evaluated based on the sum of the individual four coefficients. The minimum value can be four, and the maximum is 56. The resulting efficiency value is shown in the following table with the respective regions.

Region	**Coefficients**				**SUM**
	C_1	**C_2**	**C_3**	**C_4**	
Prague	1	1	1	1	4
Central-Bohemian	4	5	5	7	21
South-Bohemian	13	13	14	11	51
Pilsen	8	11	10	12	41
Karlovy Vary	10	12	12	5	39
Usti nad Labem	11	9	11	2	33
Liberec	9	7	8	3	27
Hradec Kralove	6	8	9	4	27
Pardubice	3	4	6	6	19

Vysocina	14	14	13	14	55
South-Moravian	2	2	2	10	16
Olomouc	5	6	4	9	24
Moravian-Silesian	7	3	3	8	21
Zlín	12	10	7	13	42

Table 6. Sum of coefficients [author]

The efficiency of rail transport in the regions is evaluated based on the sum of all coefficients. Efficiency is divided into four groups according to the corresponding number of points: very high efficiency, high efficiency, medium efficiency, and low efficiency. This division primarily has a comparative method for individual regions in the Czech Republic.

Efficiency	**Very high**	**High**	**Medium**	**Low**
Point spread	4 – 16	17 – 29	30 – 42	43 - 56
Regions	Prague South-Moravian	Pardubice Central-Bohemian Moravian-Silesian Olomouc Hradec Kralove Liberec	Usti nad Labem Karlovy Vary Pilsen Zlin	South-Bohemian Vysocina

Table 7. Efficiency of regions [author]

6. Conclusion

Nowadays, transport is an inherent method of transportation between places. The article dealt with the effectiveness of the use of rail transport in individual regions in the Czech Republic. The first chapter described transport in general. The following part dealt with transport on the territory of the Czech Republic. The next chapter dealt with the analysis of rail transport itself, where individual methods of evaluating coefficients were described. The last chapter dealt with the efficiency of rail transport in the Czech Republic, which divided the efficiency into four groups: very high efficiency, high efficiency, medium efficiency, and low efficiency. The Prague region and the South Moravian region belong to very high efficiency. High efficiency includes the Pardubice region, the Central Bohemian region, the Moravian-Silesian region, the Olomouc region, the Hradec Kralove region and the Liberec region. Medium efficiency includes the Usti nad Labem Region, the Karlovy Vary Region, the Pilsen Region and the Zlin Region. Low efficiency includes the South-Bohemian region and the Vysocina region. Based on the results, it is clear that more emphasis on using rail transport should be for medium and low-efficiency groups.

The results of the article and the evaluation of the efficiency of rail transport can positively impact other types of transport and their use. For example, in regions with a higher efficiency of rail transport, it should not hurt other types of transport. In regions with a lower efficiency in rail transport, there is a higher probability of inefficient use of other types of transport (for example, traffic jams, overcrowded buses, etc.). It follows from this that it is a direct ratio of the use of individual transport in the region. As the efficiency of one type of transport increases, the efficiency of other increases proportionally.

As part of the negative impact, it could be the need to create new transport lines and possibly purchase additional means of transport. Moreover, these activities increase the costs of the transport company.

The limit of the article is data from 2022, as the yearbook is constantly updated at the end of the year. In the future, it is advisable to create efficiency for other types of transport and evaluate and compare them.

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