Potential Valuation of Route Prague – Trutnov after D11 Completion

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Abstract: In the Czech Republic, there are many regions with unbalanced competition between bus and rail transport on main transport routes. This is due to differences in the quality of transport infrastructure, the attractiveness of the region, routing traffic routes or economic attractiveness for new investors and industry. The aim of this article is to evaluate the potential for bus operators on the route from Prague to Trutnov after completion of D11 highway project.

1. Introduction

There are lots of transport routes, which are dominated by one transport mode, where the alternate modes are at a disadvantage due to the lack of quality and fast infrastructure, differences in demographic and economic factors or low number of attractive locations in the region. For evaluating the potential of a transport route and possible expansion of transportation services in the bus service Saaty method will be used.

A transport system of a country meets the needs of individuals and enterprises located in its territory in transportation and related services. On the one hand it depends on the level of the development of state economy; on the other hand the transport system's development itself influences the GDP of the specific regions and the whole country. Transport system's development planning requires the systematic approach and the use of the indicators, which take into account its influence on the society's welfare [1].

2. Model Route Introduction

For this particular case route Prague – Trutnov has been chosen. In this region bus service is limited by unfinished D11 highway. On the other hand rail transportation is limited by older infrastructure and non-optimal routing of the railway concluding in high travel times.

When D11 is finished what is the commercial potential for bus services on this route?

2.1 Definition of Criteria

Using Saaty method, criteria has to be defined and described. So, the first step is to define valuation criteria and their description [2].

Table 1 Definition of criteria and their description. Source: authors

Criteria	Description
K1	Volume of passenger transport on the route - the higher the better
K2	Competition (ratio of bus service and rail service) - higher current ratio in rail transport means higher potential for buses
K3	Economical benefits for bus service X rail service - fare differences, no difference = 1
K4	Travel time benefits for bus service X rail service - time travel differences
K5	Economical benefits for bus service X car - difference between fare and fuel
K6	Travel time benefits for bus service X car - time travel differences

The second step is to determine the values of criteria evaluation and their weights. Every value follows the description of importance comparison between considered criteria.

Table 2 Criteria values and their description. Source: authors, based on [3-5]

Values	Description
1	criteria are equally important
3	First criteria is slightly more important than the second one
5	First criteria is more important than the second one
7	First criteria is significantly more important than the second one
9	First criteria is absolutely more important than the second one

For more decent criteria valuation values 2, 4, 6, 8 can be used. The third step is evaluation of each pair of criteria, calculating the geometric mean (GM) and criteria weight (CW).

Table 3 Criteria evaluation. Source: authors

Criteria	K1	K2	K3	K4	K5	K6	GM	CW
K1	1	0.33	5	5	3	3	2.37	0.26
K2	3	1	5	5	3	3	3.68	0.40
K3	0.2	0.2	1	3	0.2	0.33	0.38	0.04
K4	0.2	0.2	0.33	1	0.14	0.2	0.21	0.02
K5	0.33	0.33	5	7	1	3	1.63	0.18
K6	0.33	0.33	3	5	0.33	1	0.89	0.10
						Total	9.16	1

3. Model Application

This chapter deals with comparing the current scenario situation and scenario when the construction of D11 highway is completed. Evaluation of options is under the criterion method using values 1, 3, 5, 7, 9.

Scenario 0 represents current variant without completed project, Scenario 1 reflects the state after the project is completed. Scenario 1 is always based on the method of revealed preferences (eg. Willingness to Pay and Willingness to Accept), statistical data and expert estimations [6,7].
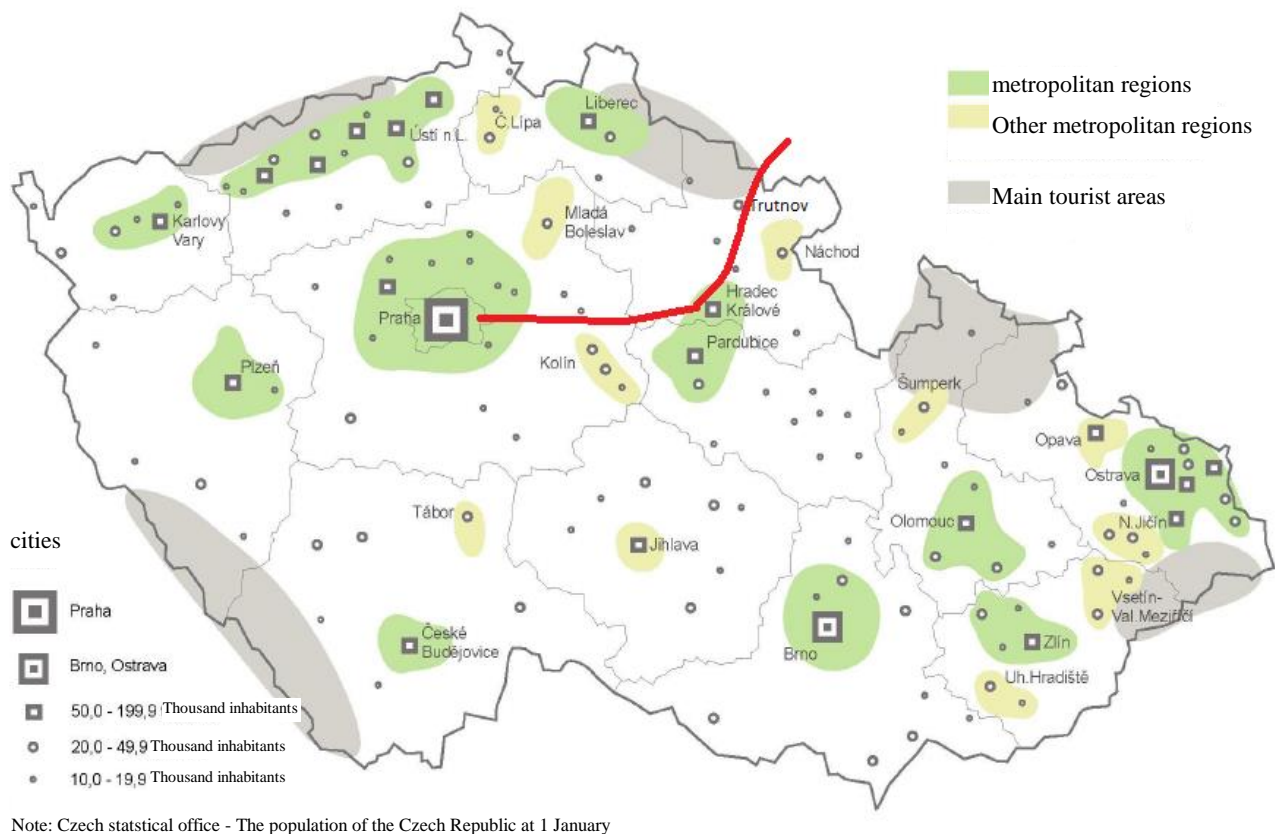

Note: Czech statstical office - The population of the Czech Republic at 1 January

Fig 1 Criteria evaluation. Source: [8,9]

Hradec Králové and Pardubice are regional centers of higher education with 12 thousand, respectively 9.5 thousand students. During the tourist seasons and on weekends it is obvious that there is an increased passenger demand due to the continuity of the transport route (bus and rail) to the Giant Mountains. Trutnov is also a catchment area for passengers from Pec pod Sněžkou, Jánske Lázně, Špindlerův Mlýn and other mountain resorts. Another important area is the Náchod region, which is characterized by a decent economic base, including tourism potential. The main transport streams from the current area can be described in Hradec Králové - Pardubice agglomeration, also directing the passenger streams to Jaroměř (and further to Liberec) and to Trutnov. In terms of interregional connection direction to Prague dominates.

Development of the number of passengers on the train connection varies according to the monitored routes. The highest increases are recorded on routes with daily commuters to Prague. Conversely, there is a slight decrease in the number of passengers in the last two years in Poděbrady - Hradec Králové route. This is influenced by a decrease in passenger volumes between Prague and Hradec Králové, probably because of improved bus service using the D11 highway. On the route from Hradec Kralove to Trutnov passenger numbers continue to rise slightly. After completion of the D11 project, significant decrease in the number of passengers on this route in favor of bus service is expected, mainly for time-saving reasons.

Interest of new bus carriers on this route is expected. It would be either an extension of the route from Prague via Hradec Králové to Trutnov, possibly up to the Giant Mountains tourist centers or extension of transportation services from / to Pardubice. At the same time, there is also the potential for alternative routing long-distance bus connections on route from Prague to Wroclaw, currently using the route via Náchod.

2.2 Data Collection

For data collection official full price fares for bus/rail services were used. Here are the data used for both scenarios [6,7]:

Scenario 0 – current state:

- route Trutnov - Prague (direct connection),
    - o bus: 138 km, 132 min., 155 CZK (fare average)
        - ▪ OSNADO spol. s r.o. – 10 connections/day
        - ▪ Trutnovská autobusová doprava s.r.o. – 2 connections/day
        - ▪ ČSAD Střední Čechy, a.s. – 1 connection/day
    - o train: 185 km, 185 min., 254 CZK
        - ▪ ČD a.s. – 7 connections/ day
    - o car: 156 km, 123 min, 390 CZK (calculated 2.5 CZK/km)
- route HK – Trutnov (direct connection),
    - o bus: 50 km, 60 min., 65 CZK (IREDO)
        - ▪ ARRIVA VÝCHODNÍ ČECHY a.s. – 2 connections/day
        - ▪ Trutnovská autobusová doprava s.r.o. – 2 connections/day
        - ▪ OSNADO spol. s r.o. – 5 connections/day
    - o train: 69 km, 80 min, 65 CZK (IREDO),
        - ▪ ČD a.s. – 13 connections/day
    - o car: 50 km, 50 min., 125 CZK (calculated 2.5 CZK/km – combined fuel consumption rate)

Scenario 1 – when project D11 is finished

- route Trutnov – Prague (direct connection),
    - bus: 100 km + 46 km = 146 km, 75 + 35 = 110 min. (average 75 km·h^{-1}), 155 CZK (fare average)
    - train: 185 km, 185 min., 254 CZK
    - car: 100 km + 46 km = 146 km, 60 + 28 = 88 min., 430 CZK (calculated 2.95 CZK/km - highway fuel consumption rate)
- route HK – Trutnov (direct connection),
    - bus: 46 km, 35 min., 65 CZK (IREDO)
    - train: 69 km, 80 min, 65 CZK (IREDO),
    - car: 46 km, 28 min., 135 CZK (calculated 2.95 CZK/km - highway fuel consumption rate)

Based on expert estimations, entry barriers and contractual obligations should be also taken into consideration. Also forecast of fuel prices or the energy consumption level of the modes of transport should be taken into consideration. For the model's purposes, it is necessary to define scenarios and the verbal description of the criteria:

Optimistic Option 1

K1 - a large increase in the number of bus passengers,

K2 - great potential for new lines on considered route,

K3 - economical advantage for bus transport,

K4 - very high time savings for bus transport,

K5 - significant increase economical advantage for bus compared to car,

K6 - significant reduction in travel time difference in favor of bus compared to car.

Pessimistic Option 0

K1 - a slight decrease in the number of bus passengers,

K2 - preservation of the current status,

K3 - reduction of economic advantage over rail transport,

K4 - reduction of time savings by bus over rail transport,

K5 - reducing the difference between the bus and car cost savings due to tariff adjustments, fuel price and consumption),

K6 - slight increase in time difference between bus and car travel times in favor of car.

Expected Option– Case of finished D11 highway

K1 – moderate increase in the number of passengers in bus transport,

K2 - a slight increase of number of bus connections due to the time advantage,

K3 - preservation of current status, on the HK - Trutnov session equally advantageous due to IREDO tariff conditions,

K4 - very high time savings in favor of bus transport,

K5 - moderate increase of economic benefits for bus compared to car,

K6 - a slight decrease in travel time difference in favor of bus compared to car.

Pessimistic option assumes that highway D11 will not be extended and the current length of finished highway stays the same. Optimistic option assumes finishing of D11 highway in projected time with no delays and with overrated expectation in favor of bus transport. Expected option assumes finishing of D11 highway in longer time than projected. Expectations are based on realistic estimations and predictions of future situation when D11 is finished up to Trutnov. This should affect competition in bus transport in positive way especially for current and potential users of bus services.

2.3 Saaty Method Application

Data for both scenarios is entered in the following table.

Table 4 Saaty method application for considered scenarios. Source: authors

K1	Volume of passenger transport on the route				
		Scenario 1	Scenario 0	GM	Weight
	Scenario 1	1	5	2.24	0.83
	Scenario 0	0.2	1	0.45	0.17
			Total	2.68	1
K2	Competition – potential for new lines/carriers				
		Scenario 1	Scenario 0	GM	Weight
	Scenario 1	1	5	2.24	0.83
	Scenario 0	0.2	1	0.45	0.17
			Total	2.68	1
K3	Economical benefits for bus service X rail service				
		Scenario 1	Scenario 0	GM	Weight
	Scenario 1	1	1	1.00	0.50
	Scenario 0	1	1	1.00	0.50
			Total	2.00	1
K4	Travel time benefits for bus service X rail service				
		Scenario 1	Scenario 0	GM	Weight
	Scenario 1	1	7	2.65	0.88
	Scenario 0	0.14	1	0.37	0.12
			Total	3.02	1
K5	Economical benefits for bus service X car				
		Scenario 1	Scenario 0	GM	Weight
	Scenario 1	1	0.33	0.58	0.25
	Scenario 0	3	1	1.73	0.75
			Total	2.31	1

K6	Travel time benefits for bus service X car			
	Scenario 1	Scenario 0	GM	Weight
Scenario 1	1	3	1.73	0.75
Scenario 0	0.33	1	0.58	0.25
		Total	2.31	1

4. Results

The table contains the product of the weight of the scenarios and the weight given criterion. Furthermore, there are total values of weights for Optimistic Scenario 1 and for Pessimistic Scenario 0.

Table 5 Results for model case D11 project. Source: authors

Exp. Option – D11 project			Opt. Scenario 1			Pes. Option 0		
	Scenario 1	Scenario 0		Scenario 1	Scenario 0		Scenario 1	Scenario 0
K1	0.22	0.04	K1	0.23	0.03	K1	0.13	0.13
K2	0.33	0.07	K2	0.36	0.04	K2	0.20	0.20
K3	0.02	0.02	K3	0.04	0.00	K3	0.02	0.02
K4	0.02	0.00	K4	0.02	0.00	K4	0.01	0.01
K5	0.04	0.13	K5	0.16	0.02	K5	0.09	0.09
K6	0.07	0.02	K6	0.09	0,01	K6	0.05	0.05
Total	0.71	0.29	Total	0.90	0.10	Total	0.50	0.50

The resulting coefficient of 0.71 means that the implementation of the remaining section of the D11 motorway opens up considerable potential for bus operators in this session. At the same time it would be a greater competitive potential to the rail, while this session more attractive to individual car users, as it would shorten travel time.

5. Discussion

Presented evaluation model can be used analogously to evaluate commercial potential of high-speed rail corridors, which are considered in Ministry of Transport's strategic materials. The model, however, assumes a fully open transport market for railway carriers. Therefore this evaluation model can be considered as one of the inputs in the preparatory phase of a new transport project, because it provides with an economic analysis based on determining the attractiveness of the relationship for current and potential carriers on considered route.

6. Conclusion

After completion of the project D11 highway to Trutnov, respectively to the border with Poland, a significant increase of the competitiveness of the bus service on this route is predicted. The current potential is expressed in economic and time savings that arise from the completion of D11 project.

This assumption was confirmed in 2016 with entering Student Agency (former RegioJet) on this route, which began operating in May beginning with one pair of the buses per day despite the fact that D11 is not fully completed yet and it ends near Hradec Králové.

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