

Calculation of total costs when ensuring railway passenger transport at the Bratislava to Banská Bystrica line

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Abstract Nowadays, great emphasis is placed on the quality of services provided in rail passenger transport, which is influenced by several factors. The competition between operators in the public tender when ordering paths in long-distance rail passenger transport is very significant. The aim of this article is to analyse steps of the Slovak government in the announcement of the first public tenders to provide subsidized transport of a selected line and to determine conditions for this tender. During 2015, Slovak Ministry of Transport began to take steps towards the liberalisation of the long-distance domestic rail passenger service on the Bratislava to Banská Bystrica line, which opened up the market for domestic passenger services to a new railway company. The Bratislava to Banská Bystrica line was chosen because of the provision of sufficient transport performance and passenger flows. The liberalisation process of the Bratislava to Banská Bystrica line is still ongoing, and has entered competitive conditions and criteria stage, although the tender had yet to be concluded in 2015.

Keywords liberalization passenger transport, public tenders, long-distance transport

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1. Introduction

The partial liberalisation of the rail market in the European Union (EU) was already underway in 2010, when all European railway companies with the necessary licences and safety certificates gained access to railway infrastructure in all Member States. One of the current objectives of the common transport policy laid down in The fourth railway package is to open up the market for national rail passenger services in all Member States from 2019, while making public tenders for transport service contracts compulsory, in the public interest. A fundamental step in the liberalisation of the rail freight market has been the separation of railway infrastructure managers from railway companies and consequently providing non-discriminatory access to railway infrastructure to the railway companies in all Member States. [1]

The biggest problem in the opening up of domestic passenger transport is that the tracks upon which traffic is controlled is also subsidised by the State, because it is impossible to create a natural competitive market. The situation has improved because of the impact of European reforms, although the operation of these lines remains costly, so it is not possible to create transparent competition. For this reason, the State continues to control and subsidise traffic perfor-

mance but the possibility of public competition to secure operations on selected routes followed by their state subsidies is increasingly coming to the fore. [2]

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In 2009, the European Parliament and Council Regulation EC No. 1370/2007 came into force, which sets out the selection procedures for the award of contracts in public rail transport. The Slovak Republic's Ministry of Transport, and Development (MDV) contracted with the best railway company operating rail services (Železničná spoločnosť Slovensko, a.s., The Railway Company Slovakia Inc., or ZSSK) to carry out transport services in the public interest for a period of nine years (2011 to 2020). This contract also includes operations in regional transport, which are agreed together with operations in long-distance transport. [2].

2. Call for public tender in railway transport in Slovakia

There are two railway companies with which the State has concluded contracts for transport services in the public interest for domestic passenger transport in the Slovak Republic: ZSSK and the private railway company, RegioJet,

Inc. At present, there are two options of providing transport services in the Slovak Republic. The first is when a railway company provides transport services at its own business risk and this principle is applied to lines with sufficient capacity and performance, where there is less risk of potential financial loss to the company. Currently this type of provision of transport service is used by RegioJet Intercity on the Bratislava to Košice line. The second type is when a railway company provides transport services in the public interest. [3]

In January 2012, there was a change on the Bratislava to Košice line because of a sufficient number of services and passenger traffic flows. ZSSK started to operate its Intercity trains as commercial trains from a contract on traffic performance in the public interest. For these trains, there is a separate tariff policy, they are not subsidised by the State and the railway company operates at its own business risk. In December 2014, RegioJet started providing the same transport services on the same line, with the result that ZSSK stopped operating its Intercity trains in January 2016. In December 2016, ZSSK began to provide transport services by Intercity trains again.

There are two forms of contracts for transport services in the public interest, either by tendering the competition for traffic performance following the end of a contract, or by directly entering the selected railway company. A contract for transport services in the public interest by direct assignment to a railway company was realised on the Bratislava to Komarno line. The Ministry of Transport carried out a tender and awarded the transport service to a specific railway company, RegioJet. The contract was agreed in December 2010 for a period of nine years from March 2012 to December 2020 and the contracted transport performance was stipulated at 1.3 million train kilometres. [3]

The analysis by Ministry of Transport showed that, after RegioJet took on the railway passenger transport March 2012, there was visibly increased train traffic on this track (from Dunajská Streda to Bratislava there is a one hour period during the day, and half an hour period during peak time), and as a result there is a significant increase in transport performance. Year on year, in the period October 2012 to October 2013, there was an increase of 74% in train kilometres, 146% in passenger kilometres, and 115% in the number of passengers of. It was also noted that there was a reduction in the cost per train kilometre of 5.7€, which represents a cost reduction of 16% when compared with a national carrier. [3]

In September 2015, the first competition for subsidised services in the public interest started, when advance notice of invitation to tender for the long-distance Bratislava to Banská Bystrica line was published and, in November, the tender was declared without publication of the estimated value of services. The price of the services, however, was estimate at over 10 million euros. The deadline for this competition was January 2016 and eight candidates enrolled. The competition was not evaluated. [4]

3. Long-distance line Bratislava to Banská Bystrica

The object of the competition was to ensure safe, effective and quality transport services to passengers between the cities of Bratislava and Banská Bystrica by long-distance trains. The contract for transport services in the public interest will be concluded with an eventual candidate under the Act of Railroad No. 514/2009. Annual transport performance is expected to be in the range of about 1.5 million train kilometres and the extent of transport operations for the year will be specified by a special addition to the contract. For realised traffic performance, the State will reimburse verifiable losses to the railway companies. In 2016, the extent of total transport performance at ZSSK represented 31,304 million train kilometres, thus the competitive amount represents 4.79% of train kilometres operated by ZSSK. [3]

The Ministry declared that one of the objectives of the competition was to generate the most favourable economic conditions for both the State and the passenger, while ensuring the operation of services achieved the required quality. The State currently reimburses around 6.7€ per train kilometre to ZSSK. Provisionally in this contest it envisaged the inclusion of eight pairs of express trains, which run daily, and two pairs of relief trains running on Friday and Sunday. [5]

The 2016/17 timetable on the Bratislava - Banská Bystrica line operates nine direct express trains, including eight trains in a two-hour period during the day. Also in the opposite direction, there are nine direct express trains, including three trains in the morning one-hour period and the remaining six trains in a two-hour period. The transport has a length of 230 kilometres, achieved travel time is three hours 24 minutes and the average cruising speed is 67.6 kilometres per hour.

4. Proposal for ensuring rail passenger transport on Bratislava – Banská Bystrica line

When creation proposal of long-distance rail passenger transport of Bratislava – Banská Bystrica line we take into account the conditions, which were set out in the Notice of public tender announced by the Ministry of Transport. The total extent of the services is defined as the minimum level. To fulfil the object of the contract it is required at least 7 trains or train units with a minimum capacity of 530 seats for each train or train unit. It is also required the creation of at least one operational reserve (one train or train unit). An analysis of the current timetable for the case study contemplated 9 pairs of trains category fast train (R). Based on the circulation of train sets were found to be necessary to ensure the required performance to the line 6 trains or multiple units and 1 operational margins. We will consider deploying the classic sets composed of an electric locomotive eligible operating on AC electric systems and 7 wagons of classical construction, also seven locomotives and 49 wagons together. For ensuring long-distance transport on the Bratislava - Banská Bystrica line was selected the bi-current locomotive

class 361.1. This locomotive has four axles, a box shape and it's design speed is 160 kilometres per hour. It is designed for trains on electrified lines, where the electricity supply system is changing. To ensure rail passenger transport in required quality services, they were also selected second class carriages (Bdteer class) for passengers. These wagons are intended for long-distance transport and designed to meet the requirements of international transport and interoperability. Bdteer carriage has open-space interior and the automatic sliding entrance doors, which speed up passengers boarding. [3]

Calculation of total costs, which may be incurred when providing passenger rail transport at the selected relation, is based on the average costs calculated per year.

Railway infrastructure costs

When calculating railway infrastructure costs, it is needed to find out the gross train weight according to the formula (1): [7]

$$Q = Q_{\text{ruš}} + Q_{\text{vz}} + n_{\text{miest}} \cdot 0,08 \text{ [t]} \quad (1)$$

where Q is gross train weight [t], $Q_{\text{ruš}}$ is locomotive weight [t], Q_{vz} is carriages weight, n_{miest} is number of seats available and then the gross train weight calculation is:

$$Q = 86 + (7 \cdot 46) + (7 \cdot 80) \cdot 0,08 = 452,80 \approx 453 \text{ t}$$

Railway infrastructure costs are calculated according to the Decree of the Railway Regulatory Authority No. 3/2010 setting the charges for the access to railway infrastructure. These costs include charge for the minimal access package and charge for the access to the service devices. There are six line categories in the Decree, and because of this, lines have to be divided into categories. There is the first category line Bratislava - Palarikovo with its length 81 kilometres and the second category line Palarikovo – Banská Bystrica with its length 149 km.

First, it is needed to calculate charge for the minimal access package, according to the formula: [6], [7]

$$U_{\text{mp}} = U_1 + U_2 + U_3 \quad (2)$$

where U_1 is charge for ordering and allocation of the capacity, U_2 is charge for the management and organization of traffic, U_3 is charge for ensuring the infrastructure serviceability. Second, there is needed the calculation of charge for the access to the service devices, following the formula: [6], [7]

$$U_{\text{tp}} = U_{\text{tp1}} + U_{\text{tp2}} \quad (3)$$

where U_{tp1} is charge for using of electrical supply device and U_{tp2} is charge for using railway stations. Charges for the access to railway infrastructure according to track category are shown in the Table 1.

Table 1. Charges for the access to the railway infrastructure [€/one train]

Category	1.	2.
Track section	Bratislava - Palárikovo	Palárikovo – Banská Bystrica
U1	1.6767	2.831
U2	77.598	131.269
U3	48.10452	85.11372
Utp ₁	27.0894	
Utp ₂	25.929	

Total charges for the access to railway infrastructure is 399.6113 € per one train and 2 625 446.5 € per one train per one year.

Cost of rolling stocks

It was not possible to determine an exact rent of rolling stocks (because of trade secret) then the rent was based on acquisition cost of locomotive and carriages. Rental price was set at 65 € per hour per locomotive and 28 € per hour per carriage. The necessary number of wagons to ensure conditions for a minimum capacity of 530 seats in the train's seven wagons Bdteer series, which consists of 560 seats in the train. The cost of the carriages and locomotive are both calculated by the following formula: [6], [7]

$$N_{\text{RV}} = P_{\text{RV}} \cdot n_{\text{rok}} \cdot t \cdot n_{\text{RV}} \text{ [€/year]} \quad (4)$$

where $N_{\text{V,R}}$ are total rolling stock costs, $P_{\text{V,R}}$ is rent for locomotive/carriages, n_{rok} is number of days per year, t are hours per day, $n_{\text{V,R}}$ is the number of locomotives/carriages in all trains. Then the calculation of locomotive costs is:

$$N_{\text{R}} = 65 \cdot 365 \cdot 24 \cdot 7 = 3\,985\,800 \text{ €}$$

$$N_{\text{V}} = 28 \cdot 365 \cdot 24 \cdot 49 = 12\,018\,720 \text{ €}$$

The total rolling stock costs (for locomotives and for carriages together) are 16 004 520 € per one year.

Costs of locomotive and train crews

Costs of locomotive and train crews are calculated by using the gross wage of train drivers and conductors. The high of gross wage is based on analysis of the costs of operating the trains on the relation Bratislava – Komárno. These data were recalculated by index. The gross wage is set on 920 € for the train drivers and 750 € for the conductors. Indirect costs for train drivers is set 500 € and 300 € for the conductors. When formation the working turn for employees, the number of train drives was set on 22 people and the number of conductors was set on 88 people. Employer's contributions are at 35.2 % of gross wages. Costs of locomotive and train crews are calculated by the following formula: [6], [7]

$$N_{\text{AC,VC}} = P_{\text{AC,VC}} \cdot (CCP + N_{\text{a}}) \cdot I_{\text{mf}} \text{ [€]} \quad (5)$$

where $N_{\text{r,s}}$ are costs of train drivers/conductors, $P_{\text{r,s}}$ is the number of train drivers/conductors, CCP is the total labour

cost (gross wage + employer's contributions) and N_{nep} are indirect costs of train drivers/conductors. Then the final calculations of locomotive and train crews are:

$$N_{lc} = 22 \cdot (1317.94 + 500) \cdot \left(1 + \frac{11.33}{100}\right) = 44\,526.07 \text{ €}$$

$$N_{trc} = 88 \cdot (1014 + 300) \cdot \left(1 + \frac{11.33}{100}\right) = 128\,733.11 \text{ €}$$

Total costs of all locomotive crews are 512 534.11 € per year and for locomotive crews are 1 544 797.27 € per year.

Costs of energy

$$N_E = \frac{1}{1000} \cdot Q \cdot L_e \cdot m_e \cdot S_e [\text{€}] \quad (6)$$

where Q is total gross weight of train, L_e is the length of crossing electrified tracks, m_e is energy consumption for specific type of locomotive and S_e is rate of energy (price for 1 kWh of electricity). Then the calculation costs of energy are: [6], [7]

$$N_E = \frac{1}{1000} \cdot 453 \cdot 230 \cdot 25 \cdot 0.15 = 390.54 \text{ €/per one train}$$

Energy consumption for the locomotive type 361.1 is 25kwh/1000 hrtkm according to the Study of the Transport research centre in the Czech Republic. Total costs of energy are 2 565 847.8 € per year.

Total costs

Total costs are comprised of direct and indirect costs. Direct costs are calculated above, it means the summation of railway infrastructure costs, costs of rolling stocks, costs of locomotive and train crews and costs of energy. Indirect costs include costs of the tickets selling, costs of services for passengers in railway stations, insurance costs etc. and comprise 20 % of direct costs. The high of direct and indirect costs is shown in the Table 2.

Table 2. Calculation of total costs

Total costs [€/year]	
Direct costs	23 274 924.5
Indirect costs	4 654 984.9
Total costs	27 929 909.4

Revenues

The high of revenues was determined based on the current occupancy of all connections on the relation Bratislava – Banská Bystrica last year. The occupation is divided into three track sections on this relation (Bratislava – Šala, Šala – Levice, Levice – Banská Bystrica). There are two tables for occupancy because of considerably different number of passengers during the peak and off-peak hours. The occupation, which we consider when calculating average revenues, was decreased of the number of passengers using complimentary transport. It was considered the average rate 0.066 € per one kilometre when calculating the revenues. The occupancies (with and without the complimentary transport

passengers) and revenues during the peak and off-peak hours on selected track section are shown in the Table 3 and the Table 4. Then total average revenues for all trains on the Bratislava – Banská Bystrica line according to current occupancy are 17 205 828.34 € per one year.

Table 3. Revenues during the peak hours

Track section	Occupancy [%]	Occupancy by paying passengers [%]	Distance [km]	Revenues for one train [€]
Bratislava - Šala	95	54.15	60	1 085.79
Šala - Levice	65	37.05	72	891.49
Levice – Banská Bystrica	50	28.50	98	933.40
Banská Bystrica – Levice	60	34.20	98	1.121.08
Levice – Šala	70	39.90	72	960.07
Šala - Bratislava	85	48.45	60	971.50

Table 4. Revenues during the off-peak hours

Track section	Occupancy [%]	Occupancy by paying passengers [%]	Distance [km]	Revenues for one train [€]
Bratislava - Šala	40	22.80	60	457.18
Šala - Levice	35	19.95	72	480.03
Levice – Banská Bystrica	45	25.65	98	840.06
Banská Bystrica – Levice	30	17.10	98	560.04
Levice – Šala	45	25.65	72	617.19
Šala - Bratislava	60	34.20	60	685.76

The difference between revenues and costs is shown in the Table 5. The amount of compensation for provided services on the Bratislava - Banská Bystrica line ranges from 13.8 to 16.3 million € per year by available information.

Table 5. Revenues and costs

Revenues	18 278 923.22 €
Direct costs	23 274 924.50 €
Indirect costs	4 654 984.90 €
Total costs	27 929 909.40 €
Difference	-9 650 986.18 €

There will be new modern and well equipped trains or train units on selected line, which will provide good conditions for passengers while travelling and also ensure the higher quality and comfort ability. New selected railway undertaking has to ensure more train connections (in both directions), what will probably increase the number of passengers. Based on this, there are expected higher revenues about 10 % in future. Increasing of revenues will reduce the amount of compensation of economically justified costs.

5. Conclusions

Nowadays it is expected arrival of a new railway undertaking that will provide its transport services on selected line. Therefore, it is important to design appropriate solutions that would be beneficial not only for new provider of transport services, but also for all the travelling public. This is a significant moment in the railway market in the Slovak Republic, preparing the opening up of the market for domestic long-distance passenger rail transport for competition in the provision of transport services in the public interest. This is a comprehensive process that achieves the desired effect only if it is well prepared. The priority, from the perspective of the passenger, is transit time and it should be noted that the line for competition already has a significant competitor in the form of road traffic, with the completion of the highway R1, where travel time is two hours and 50 minutes by bus and two hours and five minutes by car.

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