https://doi.org/10.24132/jbt.2018.8.4.42_53

ENTREPRENEURIAL OPPORTUNITIES IN RAILWAY PASSENGER TRANSPORT

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Abstract: Market liberalization is a great contemporary trend in many fields of economy. Formation of a united railway market in the EU leads to liberalization of railway passenger transport, what changes the entrepreneurship strategies of transport companies. Liberalized transport market, where the transport demand is meeting with transport offer, is evolving dynamically. The purpose of market transformation is sustainable economic development besides increasing quality of transportation and people mobility. Due to market liberalization, transport companies tend to attach more importance to economic aspects. Basic objective of each transport company is to decrease the costs and increase revenues from transportation. Private railway passenger operators want to increase their market share together with national railway passenger transport companies therefore the quality of passenger transportation is getting higher, which positively influences the attractiveness of railway passenger transport. Railway passenger transport, as important part of transport system connected with mobility of people, is evaluated from operating-economic point of view. Operation part means technology, what consists of timetable, vehicle circulation, the run of the train requisites and passengers flows analysis. Internal costs calculation and revenues quantification represent economic part of the evaluation. The paper is focused on current trends of entrepreneurship in railway passenger transport market. From managerial, operational and economical point of view, there are described some ways, how to make the railway passenger transport system more effective and make the entire transport system more attractive for traveling public.

Keywords: railway passenger transport, liberalization, transport market, Lean Six Sigma methodology

JEL Classification: M11, L15, R42

INTRODUCTION

In an effort to promote and increase the competitiveness of rail transport, the European Union has taken measures to create an acceptable entrepreneurial environment. As a result of the fall in rail transport, it has taken steps towards strengthening its position and opening up the transport market. The particular procedures for its implementation were defined in the railway packages in accordance with the EU White Paper on transport and The Regulation (EC) No 1370/2007 of the European Parliament and of the Council of 23 October 2007 on public passenger transport services by rail and by road and repealing Council Regulations (EEC) No. 1191/69 and 1107/70. From the initial separation of the infrastructure manager from the railway undertakings to making the rail market available to other carriers on the basis of harmonized conditions. The process of gradual implementation has been adapted in the EU Member States at different levels since 2010 and the opening of the transport market for domestic passenger services should be completed in 2019, while an obligation to competitive tenders for Public Service Contract in most cases to be determined by 2023. On the basis of the aforementioned contract between the railway company and the competent public authority, either a public or a private railway carrier may

operate acquired the territory and thus to meet the transport requirements for passengers (Gašparík, et al., 2017).
Liberalization means the gradual opening up of the rail transport market and entry of carriers on the market on non-discriminatory terms in an effort to promote the improvement of railway transport services (Panák, et al., 2017). This allows the new private carriers to participate in the competition of selected railway lines. The legislative framework for the operation of rail transport is established between the Ministry of Transport and an infrastructure manager under a contract for the operation of railway infrastructure and between carriers on the basis of a contract on public transport services. The purpose of this relationship is to meet the needs of the public for the transportation of passengers and thus to provide economically disadvantageous rail connections where the financial loss of which will be balanced by the state. Licensed railway undertakings may provide rail transport via commercial trains or under a public service contract to meet the needs of the passengers according to the transport needs of the area. The transformation process started by division of Czechoslovak State Railways into two separate state-owned enterprises, which were later divided into an infrastructure manager and transport undertakings according to the European legislation.
The process of liberalization in the Slovak Republic was initiated by the entry of two private carriers on the railway network in the provision of rail passenger transport. In addition to the state railway carrier, two other private railway carriers nowadays provide rail transport (Harmanová, Černá, 2015). An important private carrier that entered the rail transport market is considered RegioJet, which at this time provide transport for public on the line Bratislava - Komárno and also commercial transport services on line Praha - Košice / Zvolen. However, the train link between Bratislava and Košice was canceled from 2017. In 2012, LeoExpress started to operate railway transport on frequented line Praha - Košice, which increased the train service offer. From the point of view of market access in Slovak Republic, it is direct contracting assignment for the selected railway undertaking.
In the Czech Republic, a state-owned carrier with a majority position is serving the territory via train connections with more than 90 %. Among other transport companies are included RegioJet and LeoExpress, which in most lines provide common train connections from both countries. In 2016 there was introduced a direct railway link from the Czech metropolis with the city of Nitra in Slovakia through company Arriva. At the same time, there are other companies in the Czech Republic with an even smaller share of the market which operate public transport, with the region being the contracting authority. An example is GW Train company, which operates rail transport on regional lines in areas such as Karlovarsko, Královéhradecko, Šumava and North Moravia. In the table 1, there is shown a brief summary of railway passenger market liberalization.

https://doi.org/10.24132/jbt.2018.8.4.42_53

Tab. 1: The significant railway lines within the transformation process in the Slovak and Czech Republic

	ČSD	
	1945 - 1992	
ŽSR	1993	ČD
Železničná spoločnosť, a.s.	2002	
	2003	České dráhy, a.s.
Železničná spoločnosť Slovensko, a.s.	2005	
Public	2010	Public
ZSSK		ČD
Private		Private
/Praha-Ostrava-Žilina-Košice/	RegioJet	/Praha-Ostrava-Žilina-Košice/
	2012	
/Bratislava-Dunajská Streda-Komárno/	RegioJet	
/Praha-Ostrava-Košice/	LeoExpress	/Praha-Ostrava-Košice/
	LeoExpress	/Praha-Hranice na Moravě-Staré Město u Uherského Hradiště/
	2014	
/Bratislava-Košice/	RegioJet	
	2015	
/Praha-Martin-Banská Bystrica-Zvolen/	RegioJet	/Praha-Martin-Banská Bystrica-Zvolen/
	RegioJet	/Praha-Olomouc-Přerov/
	2016	
/Praha-Brno-Bratislava/	RegioJet	/Praha-Brno-Bratislava/
/Praha-Nitra/	Arriva	/Praha-Nitra/
	2017	
	RegioJet	/Praha-Brno-Viedeň/

Source: Compiled by the authors

The liberalization process has resulted in an improvement in previous transport services as well as various additional services. This occurred mainly on the main international line Praha - Košice, where other private carriers started to operate the railway passenger transport and thus increased the quality of the provided services. The aim of the paper is to describe and analyse entrepreneurship possibilities in railway passenger transport from transport company point of view. Managerial, technological and economic aspects are deeply analysed there and practical application is shown in the case study.

1. MANAGERIAL ASPECTS OF RAILWAY PASSENGER TRANSPORT

A prerequisite for successful entrepreneurship is a creative activity that follows a well-chosen strategic management aimed at constantly improving the quality of its outputs (Nedeliaková, et al., 2015). As passenger requirements are steadily increasing, service providers need to change the old paradigm, develop a strategy, and focus on continually optimizing processes and thus improving overall quality. The business environment opens up space for perceiving the problem as a new challenge and come up with a new solution that will create a better working environment for staff and provide more attractive services to customers (Nedeliaková, et al., 2016). The introduction of process management in the enterprise is nowadays considered to be self-evident and results in the creation of a functioning

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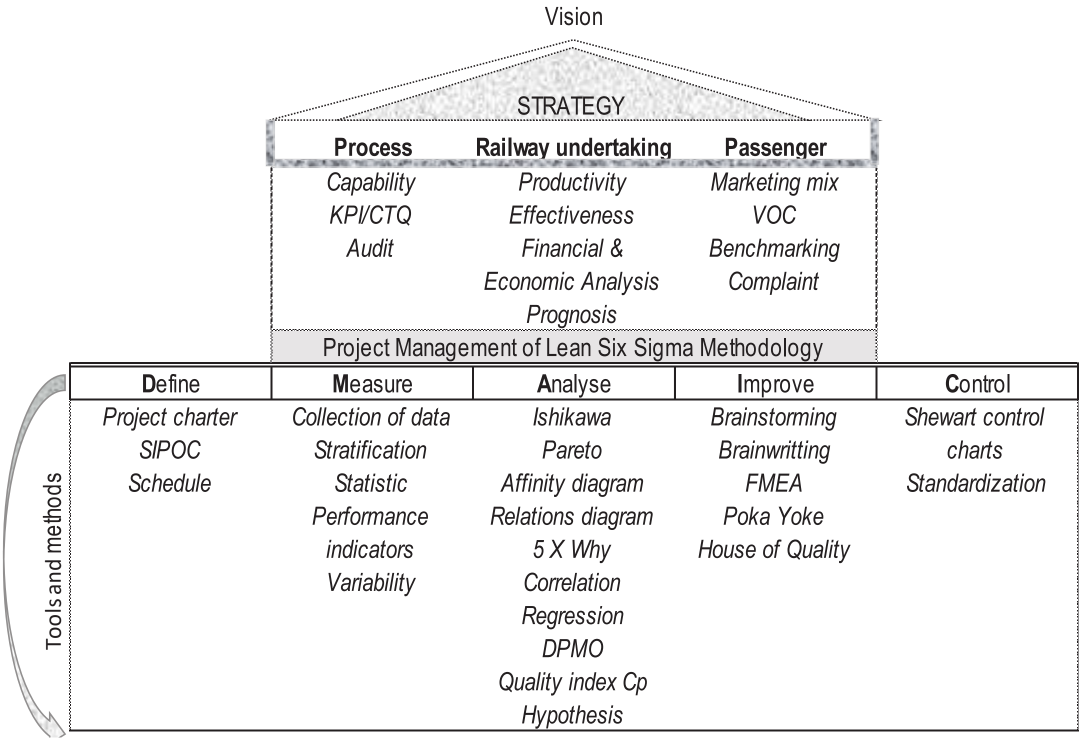
organization capable of flexibly responding to a changing environment. The next step is to prioritize and decide to implement a quality methodology from a wide range of qualitative approaches.

In terms of success in the transport market, it is only a matter of time when every railway company will be forced to invest all their effort to quality and trying to constantly satisfy the needs for their customers which can be done only by comprehensive knowledge (Nedeliaková, et al., 2013). Since the rail passenger market has been made available, private transport undertakings have the opportunity to participate in railway transport operations, thereby comparing the portfolio of provided services. The newly created situation as a result of liberalization has created other conditions and environments, which in particular has affected the dominant monopoly position of the state-owned railway carrier and has opened the door to other railway transport operators. From this reason, future focus of each transport undertaking should provide better services for passengers with favorable travelling experiences (Štefancová, et al., 2016). This leads to more competitive pressure, where it is necessary to properly connect managerial skills and apply the marketing concept of business in striving to attract a passenger to the use of transport services. The figure 1 shows the enterprise structure with applied process management and the Lean Six Sigma quality approach.

Fig. 1: Implementing quality approach to business process management



Source: compiled by the authors

At the beginning, every transport undertaking should set a vision and define an accurate strategy for further direction its processes. When considering the most appropriate strategy, it is necessary to conduct a market survey and a forecast of developments in the transport market. Depending on the determination of competitive power through the method of Benchmarking, it is possible to choose a market segment and a portfolio of offered services and then to apply qualitative methods. At present, one of the most preferred is the Lean Six Sigma methodology, which can also be applied to railway transport processes. Before running its principles into normal business operations and starting with qualitative projects, it is important to train staff according to level of management.

Lean Six Sigma is a structured approach and provides a comprehensive set of tools and methods within the DMAIC cycle that can be used to achieve improvement. It is considered a systematic way to enhance existing processes or concept to design new processes or transport services. The five phases cycle is used as a helpful framework to solve the proposed problem, with the first step defining the exact wording of the project, determining competencies and purpose in project document. This concept focuses mainly on satisfying customers' needs, so it should be precisely described as Critical to Quality, which results from the transformation of Voice of Customer into measurable requirements. SIPOC diagram helps to visualize the relationship between process, supplier, customer, input and output what in the case of the transport market means the relationship between infrastructure manager, transport undertakings and passengers. In order to analyse actual productivity and effectiveness of the company and capability of the processes, the measure phase focuses on collecting adequate data. Accurate data enables quantify and verify company performance and determines process variability based on discrete or continuous data. Depending on the complexity of processing and interpreting data, there is used sophisticated statistical software in most cases. This can be the case when using correlation and regression analysis or analysing very large amount of data. This methodology encompasses a wide range of tools that can be used across phases and therefore depend only on the transport undertaking which ones are beneficial and are able to improve the quality of provided services. Ishikawa diagram plots a simplified fish skeleton where the causes of the problem are assigned to the key effect. Appropriate tool to identify the most problematic area in a business is the Pareto diagram that illustrates the relative importance of causes in an approximate ratio 80/20. After generating ideas for solving problems by Brainstorming or Brainwritting, these are gradually grouped into Affinity diagram according to natural relationships. The FMEA is considered to be a risk management method in an enterprise that analyzes possible errors and their future consequences and subsequently proposes corrective actions. During the last control phase, there is recommended to use the Shewart control diagrams for indication the range of variability and comparison of the analyzed process at the end of the cycle.

Lean Six Sigma features approach that can be used to deeply understanding defects in processes and through five steps to gain better quality of the services offered in railway passenger transport. Achieving the required status is conditional upon the correct knowledge of the chosen tools as well as the correct application in a particular transport company. Railway companies should take only those tools that are appropriate to achieve successful improvements. The aim of this approach is to focus not only on the profit of the company but also on the requirements of its passengers. At the same time, they should not forget about the requirements of their employees and properly build a motivation system.

2. TECHNOLOGICAL ASPECTS OF RAILWAY PASSENGER TRANSPORT

Passenger transport is divided into individual and public. Individual passenger transport includes walking, cycling and car transport. Public passenger transport includes railway, road, water, air, city and unconventional transport. From spatial point of view, passenger transport is divided into local, regional and long-haul, which is then divided into interregional transport (in one country) or international transport (among two or more countries). From operation point of view, passenger transport is the sum of acts for providing mass transport of passengers which includes boarding, selling and checking the travel tickets, transfer of passengers' luggage, ensure all individual needs of passengers and organizing of other complementary services. From economics point of view, passenger transport is classified into tertiary sphere – services. It means that there are not any material production values, but it is reflected in costs. In general, passenger transport has got a great social and political importance. Legislative fundamentals of organizing and managing the passenger transport are constituted in higher legal standards and internal regulations of transport companies. Passenger transport is generally considered as an activity, which arises as the consequence of spatial division of places, where people are in exact time and their need to move. Motivators for moving could be commuting (job or education), dealing with personal or working matters, travelling for vacation (hiking, sport, health, cultural and social facilities), visiting relatives and friends (Dedík, et al., 2017). Requirements for transport of passengers originate in their need to move, while the passenger transport is dependent on the willingness of travelling. In passenger transport, there are mostly individual passengers, so it is difficult to determine all transport requirements. Basic and general factor, which has got a significant impact to the transport of passengers, is demography. Specifically, the most relevant aspects are the progress of population quantity, economic and social indicators, standards of living, age structure, employment rate and disposable income. Regularity of transport offer is also key factor, which depends on structure of passengers and their reasons for travelling (Škorupa, et al., 2017). Other specific factors are spatial accessibility of transport hub and price for transportation. Influences on transport offer are geography, transport infrastructure, transport vehicles and environment. Transport infrastructure factor consists of its structure, length, density, throughput, availability to residences and overall quality.

3. ECONOMIC ASPECTS OF RAILWAY PASSENGER TRANSPORT

Technology for operation of long-haul passenger trains is created by the transport company and passengers usually do not know it. They know only the timetable, what represents transport offer – number of connections on the route. Temporal position of trains, which are listed in the timetable, must be attractive for passengers. This can be made by harmonisation of departures and arrivals. It means that the departure time from all transport hubs on the route is always in the same minute, but the hour is different. Passengers could easily remember all departures and it also improves the transport accessibility in the selected area from temporal point of view. It means that there is the same time gap between departures of trains and thanks to periodicity of departures, the transport accessibility is increased. Timetable is created separately for both directions of trains. It must include all trains, their departures, stations and stops names, trains numbers and distances. Transport time between each station and stop must be determined by technical specifications of selected vehicle, which operates on the route. Number of vehicles, which are necessary for operation of all trains included in timetable, is defined in vehicles circulation. It is divided into operation days and there is showed the sequence of trains for each vehicle and the following day. All technological acts are considered. Thanks to vehicle circulation, all vehicles have got same or very similar number of driven kilometres. Other part is a run of the train requisites. Train requisites are subjects, which are necessary to be supplemented into the vehicle, to create an object, which can move within the transport process independently. Train requisites are vehicle-drivers and stewards. Sequence of the train requisites is regularly repeated schedule of their working time. Working time for vehicle-drivers and stewards are generated separately. Sequence of the train requisites must respect higher legal standards, mostly Labour Code. Thanks to sequence of the train requisites, the exact number of staff – vehicle drivers and stewards, is known. From economic point of view, there must be operating costs calculation. Costs are financial representation of company sources consumption for realizing services per time. Internal costs of the transport company arise from operation of trains on railways. Thanks to calculation, the exact amount of these costs is known. In railway passenger transport, the calculation unit is the service – transporting of passengers. It can be defined by quantity (number of trains, vehicles), time (staff working time, time of traveling) or other way (passenger-kilometres, train-kilometres). In the case study, there are these costs: vehicle costs (price for vehicle, repairs and maintenance, insurance, operational cleaning), railway infrastructure access, staff costs (wages of vehicle-drivers and stewards), traction energy consumption and other indirect costs (management, marketing, travel ticket selling system, information system etc.). Sum of all costs, which are converted to one typified train on the route, is the base for making the tariff charges (Dolinayová, 2018).

Railway vehicle costs are calculated this way:

$$r_{trkm}^{RV} \frac{D_Y + \Sigma RM_Y + OC_Y + INS_Y}{\text{Ø } annual\ vehicle\ kilometrage} \quad (1)$$

where:

r^{RV}_{trkm} – railway vehicle costs rate for train-kilometre [€/trkm]

D_Y – depreciation of vehicle per year [€]

ΣRM_Y – entire costs for repairs and maintenance of vehicle per year [€]

OC_Y – entire costs for operational cleaning of vehicle per year [€]

INS_Y – entire costs for vehicle insurance per year [€]

Ø annual vehicle kilometrage – average kilometrage of railway vehicle per year [km]

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$$C_{RV} = \Sigma trkm \,.\, r^{RV}_{trkm} \,.\, NRV_{tr} \quad (2)$$

where:
C_{RV} – entire railway vehicle costs per route [€]
$\Sigma trkm$ – sum of train-kilometres per route
r^{RV}_{trkm} – railway vehicle costs rate for train-kilometre [€/trkm]
NRV_{tr} – number of railway vehicles in the train on the route [vehicles]

Staff costs are calculated this way:

$$r^{S}_{emph} = \frac{price\ for\ working + equipment}{\Sigma\ work\ time} \quad (3)$$

where:
r^{S}_{emph} – staff costs rate for employee-hour [€/emph]
price for working – all month company's costs for the employee [€]
equipment – month costs for equipment of employee [€]
Σ work time – entire month work time of employee [hours]

$$C_S = t_r \,.\, CR_S \,.\, r^{S}_{emph} \quad (4)$$

where:
C_S – staff costs per route [€]
t_r – train ride time [hours]
CR_S – conversion ratio: train ride time □ employee-hour (how much emph is necessary for one train drive)
r^{S}_{emph} – staff costs rate for employee-hour [€/emph]

Traction energy consumption costs are calculated this way:

$$C_{TEC} = \frac{\Sigma gtkm \,.\, mc_{TE} \,.\, s_{TE}}{1000} \quad (5)$$

where:
C_{TEC} – entire traction energy consumption costs per route [€]
$\Sigma gtkm$ – gross-tons-kilometres per route (weight of vehicle + weight of passengers)
mc_{TE} – measurable consumption of traction energy per thousand gross-tons-kilometres
S_{TE} – traction energy rate [€]

From operating costs calculation, tariff rates can be appointed. The tariff reflects valuable relations among operator and passengers. These rates must include internal goals of the transport company (increasing profit, decreasing costs, market share etc.), social sphere (quality and offer of public transport, reducing regional gaps etc.) and environmental aspects. Current transport demand and complementary transport offer are also important part of setting tariff rates. Fare is based on costs and appropriate profit and it is also dependent on transport demand and competition. Discounts are provided by the transport company according to its transport politics and marketing strategy (Široký, 2017). Operating costs and transport revenues are compared in the operating-economic evaluation. Revenues are result of multiplying number of passengers with tariff rates, separately for each segment on the whole route. Comparison of costs and revenues express the economic efficiency of the route – revenues must be higher than costs. If the revenues are not higher than costs, operation of long-haul passenger trains is not efficient from economical point of view and the transport company must find external financial sources or simply remake the route.

4. CASE STUDY

The case study is applied on the fictional route Plzeň hl. n. – Bratislava hl. st. Trains on this route should stop in stations Praha hl. n., Pardubice hl. n., Brno hl. n. and Břeclav because these stations are important transport hubs and regional centres with great catchment areas. Operation of long-haul passenger trains on this rout is ensured by unspecified vehicle with average technical parameters, similar to real vehicles, which operate on the railway infrastructure. Travel time respects all technical parameters of the vehicle as well as track. Timetables for both directions are shown in table 2 and 3.

Tab. 2: Timetable of trains in direction from Plzeň hl. n. to Bratislava hl. st.

Km	Train	Ex 551	Ex 555	Ex 559
	From:			
0	**Plzeň hl. n.**	5:00	11:00	17:00
107	Praha hl. n.	6:18	12:18	18:18
211	Pardubice hl. n.	7:14	13:14	19:14
362	Brno hl. n.	8:47	14:47	20:47
421	Břeclav	9:19	15:19	21:19
503	**Bratislava hl. st.**	10:08	16:08	22:08
	To:			

Source: Authors

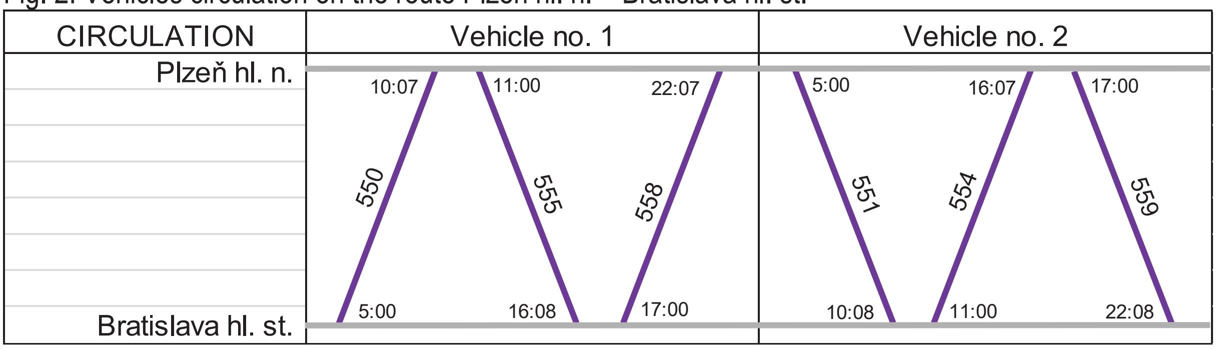
Tab. 3: Timetable of trains in direction from Bratislava hl. st. to Plzeň hl. n.

Km	Train	Ex 550	Ex 554	Ex 558
	From:			
0	**Bratislava hl. st.**	5:00	11:00	17:00
82	Břeclav	5:51	11:51	17:51
141	Brno hl. n.	6:23	12:23	18:23
292	Pardubice hl. n.	7:54	13:54	19:54
396	Praha hl. n.	8:55	14:55	20:55
503	**Plzeň hl. n.**	10:07	16:07	22:07
	To:			

Source: Authors

Next step is vehicles circulation. It shows the exact number of vehicles, which are necessary to realize the timetable. In one train, at least one vehicle is necessary, but there could be more vehicles. In the case study, one vehicle is on each train (vehicle = train set, for instance locomotive+vagons or motor units). There are two vehicles, which are necessary for operation of all trains on the fictional route from Plzeň hl. n. to Bratislava hl. st.

Fig. 2: Vehicles circulation on the route Plzeň hl. n. – Bratislava hl. st.



Source: Authors

Vehicle circulation is the base for determine driven kilometres of vehicles. It also influences operating costs calculation, because all vehicle costs are divided with average kilometres. Both vehicles have got the same kilometrage per day – 1509 km/day per one vehicle 550 785 km/year per one vehicle.
Other important part is the run of the train requisites. Train requisites in passenger railway transport are vehicle-drivers and train crew – the necessary personnel of each train. There are one vehicle-driver and four members of train crew in each train. Their starting and termination point is Plzeň hl. n.. Necessity means number of necessary persons for trains. In the first row there are numbers of trains, in which are vehicle-drivers or train crew. Under the numbers of trains, there is start and the end of the working time.

Fig. 3: Sequence of vehicle-drivers on the route Plzeň hl. n. – Bratislava hl. st

<table>
<tr><th colspan="13">RUN OF VEHICLE-DRIVERS</th></tr>
<tr><th colspan="3">Necessity</th><th colspan="10">Day number</th></tr>
<tr><td rowspan="9">Workplace</td><td rowspan="9">PLZEŇ HL. N.</td><td rowspan="9">8,17</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td><td colspan="2">4</td><td colspan="2">5</td></tr>
<tr><td colspan="2">551/554</td><td colspan="2" rowspan="2">free day</td><td colspan="4">559/---/550</td><td colspan="2" rowspan="2">free day</td></tr>
<tr><td>4:30</td><td>16:30</td><td>16:30</td><td>22:30</td><td>4:30</td><td>10:30</td></tr>
<tr><td colspan="2">6</td><td colspan="2">7</td><td colspan="3">8</td><td colspan="3">9</td></tr>
<tr><td colspan="2" rowspan="2">free day</td><td colspan="2">555/558</td><td colspan="3" rowspan="2">free day</td><td colspan="3" rowspan="2">free day</td></tr>
<tr><td>10:30</td><td>22:30</td></tr>
<tr><td colspan="10">Working time (hours)</td></tr>
<tr><td colspan="2">Σ day</td><td colspan="2">Ø day</td><td colspan="3">Σ month</td><td colspan="3">Ø month</td></tr>
<tr><td colspan="2">42,00</td><td colspan="2">4,67</td><td colspan="3">1260,00</td><td colspan="3">140,00</td></tr>
</table>

Source: authors

Fig. 4: Sequence of stewards on the route Plzeň hl. n. – Bratislava hl. st.

<table>
<tr><th colspan="13">RUN OF TRAIN CREW (4 members)</th></tr>
<tr><th colspan="3">Necessity</th><th colspan="10">Day number</th></tr>
<tr><td rowspan="9">Workplace</td><td rowspan="9">PLZEŇ HL. N.</td><td rowspan="9">7,35</td><td colspan="2">1</td><td colspan="3">2</td><td colspan="2">3</td><td colspan="3">4</td></tr>
<tr><td colspan="2">551/554</td><td colspan="3" rowspan="2">free day</td><td colspan="2">555/558</td><td colspan="3" rowspan="2">free day</td></tr>
<tr><td>4:30</td><td>16:30</td><td>10:30</td><td>22:30</td></tr>
<tr><td colspan="2">5</td><td colspan="2">6</td><td colspan="3">7</td><td colspan="3">8</td></tr>
<tr><td colspan="4">559/---/550</td><td colspan="3" rowspan="2">free day</td><td colspan="3" rowspan="2">free day</td></tr>
<tr><td>16:30</td><td>22:30</td><td>4:30</td><td>10:30</td></tr>
<tr><td colspan="10">Working time (hours)</td></tr>
<tr><td colspan="2">Σ day</td><td colspan="2">Ø day</td><td colspan="3">Σ month</td><td colspan="3">Ø month</td></tr>
<tr><td colspan="2">42,00</td><td colspan="2" rowspan="2">5,25</td><td colspan="3">1260,00</td><td colspan="3" rowspan="2">157,50</td></tr>
<tr><td colspan="3">8 x 4 = 32 persons</td><td colspan="2">168</td><td colspan="3">5040</td></tr>
</table>

Source: authors

Economical part of the design consists of operating costs calculation. There are many enumerations, because all costs must be identified and quantified. Railway vehicle costs rate is quantified by formula (1) and the calculation is shown in the table 4.

Tab. 4: Railway vehicle cost rate on the route Plzeň hl. n. – Bratislava hl. st.

RAILWAY VEHICLE COST RATE	
Price (€)	15000000
Years of using	30
Repairs and maintenance (€/year)	225000
Operational cleaning (€/year)	17000
Insurance (€/year)	30000
Annual vehicle kilometrage	550785
Resultant rate	1,40

Source: authors

Staff costs are calculated separately for vehicle-drivers and train crew. Firstly, the cost rate must be calculated. Key part is price for working – all costs of the transport company for one employee. All staff costs rate is quantified by formula (3). Train crew are less qualified than vehicle-drivers, therefore price for working is lower. Equipment costs are higher, because stewards are communicating with passengers, therefore they must have always clean and modern uniform for good propagation of the transport company. Train staff cost rates are calculated in tables 5 and 6.

Tab. 5: Vehicle-driver cost rate on the route Plzeň hl. n. – Bratislava hl. st.

VEHICLE-DRIVER COST RATE	
Price for working (€/month)	2600
Equipment (€/month)	40
Average work time (hours/month)	140,00
Resultant rate	18,86
Conversion ratio	1,37

Source: authors

Tab. 6: Train crew cost rate on the route Plzeň hl. n. – Bratislava hl. st.

TRAIN CREW COST RATE	
Price for working (€/month)	1600
Equipment (€/month)	70
Average work time (hours/month)	157,50
Resultant rate	10,60
Conversion ratio	1,37

Source: authors

Basic precondition for the operating costs calculation is determination and summarization of all necessary inputs and other transport indicators, which are important parts for the calculation. When all inputs and transport indicators are known, the operating costs can be calculated. Costs per typified train are quantified by formulas (2), (4) and (5). Costs for infrastructure and indirect costs are quantified separately, according to methods hereinbefore. Cost calculation is shown in the table 7.

Tab. 7: Operating costs per typified train on the route Plzeň hl. n. – Bratislava hl. st.

Route: Plzeň hl. n. - Praha hl. n. - Brno hl. n. - Bratislava hl. st.		
INPUTS		
Number of vehicles	1	
Gross weight	370	tons
Distance	503	km
Number of seats	340	
Average travel time	5,13	hours
Vehicle-driver work time	7,00	hours
Train crew work time	7,00	hours
Railway vehicle costs rate	1,40	€/trkm
Vehicle-driver costs rate	18,86	€/emph
Train crew costs rate	10,60	€/emph
Number of train crew persons	4	
Price for electricity	0,1	€/kWh
TRANSPORT INDICATORS		
trainkilometers	509	trkm
Sum of grosstonskilometers	186110	gtkm
Energy consumption	21	kWh/1000gtkm
COSTS		
Vehicle (€)	713,43	24,26%
Infrastructure (€)	819,89	27,88%
Vehicle-driver (€)	132,00	4,49%
Train crew (€)	296,89	10,09%
Electricity (€)	390,83	13,29%
Indirect (€)	588,26	20,00%
Sum (€)	**2941,30**	100,00%
converted to 1 seat (€/seat)	5,85	
converted to 1 seatkm (€/seatkm)	0,015804	

Source: authors

Revenues are calculated by multiplying of transport flows and tariff rates on each transport relations. Transport flows are determined by passenger counting in trains. Final and the most important part is the operating-economic evaluation, where revenues are compared with operating costs. Economic efficiency of the route is the result of this comparison and the operation of trains on the route is efficient in the case, when the result is higher than zero – revenues cover all costs. Operating-economic evaluation of the long-haul train route in the case study above shows the efficiency of the route. When revenues per train are higher than costs per train, the transport company can operate trains on the route according to submitted technology and external sources are not necessary.

CONCLUSION

The primary idea of liberalization is to allow licensed public or private enterprises non-discriminatory access to the transport market in order to increase the position and economic efficiency of rail transport and to provide high-quality transport services in line with passenger requirements. Although the legislative framework for the liberalization of the transport market is in line with the European legislative framework, there is still space for improvement of the business environment and better regulation of the conditions for the award of public procurement contracts and for the conclusion of public service contracts.

From the point of view of success in railway transport, it is necessary for carriers to apply qualitative approaches in processes and thus to be able to keep up with successful competitors. The process of railway passenger market liberalization influences contemporary progression in the whole passenger transport system. There are several ways how to evaluate this process, because it has got different consequences to traveling public and transport companies, which also vary in each country according to its legislation and economic conditions. Market share growth of private transport companies is a basic result of liberalization and it is proportionally connected with improvement of transport qualitative criteria and increasing attractiveness of railway passenger transport. Private transport companies are focused on costs optimization and making higher profit therefore railway passenger transport market is significantly affected by economic aspects. These aspects are mainly internal costs, transport demand and level of competitiveness. In central Europe, there are some private railway passenger transport companies with different strategies. In the case study, there is an example of operation-economic evaluation, which is applied on the fictional route Plzeň hl. n. – Bratislava hl. st.. This evaluation shows the efficiency of long-haul passenger trains operation on the route according the proposed technology and timetable.

REFERENCES

Dedík, M., Gašparík, J., Záhumenská, Z. (2017). Quality Assessment in the Logistics of Rail Passenger Transport. *18th International Scientific Conference on LOGI*. České Budejovice, Czech republic, 2017.

Dolinayová, A. (2018) Optimisation of Business Processes and Services in the Rail Transport Market from Two Points of View: Economic Efficiency and Management. *Conference on Sustainable Rail Transport (RailNewcastle)*, 31-44.

Gašparík,J., Meško, P., Záhumenská, Z. (2017). Methodology for Tendering the Performances in Long Distance Rail Passenger Transport. In: *Periodica Polytechnica Transportation Engineering*. Budapest, Hungary, 2017.

Harmanová, D., Černá, L. (2015). Účinnosť dopravno – politických opatrení vo verejnej osobnej doprave. In: *Doprava v regióne východné Slovensko*, Košice, 2015.

Nedeliaková, E., Dolinayová, A., Nedeliak, I. (2015). *Rail Transport Management*. Bratislava: DOLIS s.r.o.

Nedeliaková, E., Sekulová, J., Nedeliak, I., Ľoch, M. (2013). Methodics of identification level of service quality in railway transport. *Contemporary Issues in Business, Management and Education*, 320-329.

Nedeliaková, E., Štefancová, V., Kudláč, Š. (2016). Total service management application in passenger logistics. *Logi: scientific journal on transport and logistics*. 7(2), 91-99.

Panák, M., Nedeliaková, E., Abramović, B., Šipuš, D. (2017). Synergies of the Liberalization of the Railway Transport Market. *LOGI: 18th International Scientific Conference*. Vol. 134.

Široký, J. (2017) Price for the Allocation of Railway Infrastructure Capacity as a Tool for the Improvement of Train Transport Planning. *18th International Scientific Conference on LOGI*. České Budejovice, Czech republic, 2017.

Škorupa, M. Kendra, M. (2017). Proposal of backbone public transport lines in the Upper Saris region. *Transcom: 12th International scientific conference of young scientists on sustainable, modern and safe transport*. 800-805.

Štefancová, V., Nedeliaková, E., López-Escolano, C. (2016). Connection of Dynamic Quality Modeling and Total Service Management in Railway Transport Operation. *Transcom: 12th International scientific conference of young scientists on sustainable, modern and safe transport.* 834-839.