

POSSIBILITIES FOR THE DEVELOPMENT OF INTERNATIONAL RAIL PASSENGER TRANSPORT BETWEEN SLOVAKIA AND THE CZECH REPUBLIC IN THE POST-COVID PERIOD

Abstract. The contribution is focused on the analysis of the current state and development of traffic service in international rail passenger transport between Slovakia and the Czech Republic. The current situation in the post-covid period is analysed in more detail from several points of view. The frequency of passengers at individual border crossings in the monitored period is also briefly analysed. Part of the analysis of the work is a proposal for ways to improve the current traffic service at individual border crossings in international rail transport.

Keywords: railway passenger transport, post-pandemic period, long-distance, transportation process, quality

Milan Dedík¹

¹ Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3428; milan.dedik@uniza.sk

Pavol Meško¹

¹ Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3433; pavol.mesko@uniza.sk

Miriám Garbárová¹

¹ Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3128; miriam.garbarova@uniza.sk

Jaroslav Frnda¹

¹ Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3285; jaroslav.frnda@uniza.sk

Introduction

The main advantages of railway passenger transport are primarily its safety, environmental friendliness and high transport capacity. Currently, rail transport is one of the most frequently used resource modes for transporting passengers over a certain distance. It is necessary to maintain the railway infrastructure in a high-quality technical condition so that it provides certain benefits in a longer period of time for society. International long-distance rail transport plays an important role in supporting the European single market. The development of this type of transport contributes to the fulfilment of a whole range of goals, among which is the creation of a safe and fully interoperable unified European railway system, improvement of sustainability. Other aspects of development are the creation of jobs, strengthening the connectivity of territories with special emphasis on remote regions. The key elements are the protection of passenger rights, equal accessibility, improvement of traffic service, operational efficiency, and above all, reduction of time spent traveling.

The performance reduction of passenger train transport was caused by the pandemic in the spring of 2020, when the borders were closed and thus no train service ran. Even after the re-opening of the borders, strict measures were in place, when passenger frequencies dropped significantly. In 2022, the situation has improved significantly, but it is still necessary to offer new and more attractive solutions for passengers. Such solutions should be offered so that passenger frequencies increase in the current post-pandemic period (Slovak Republic, 2020).

The aim of contribution is to analyse the current state and development of traffic service in international rail passenger transport between Slovakia and the Czech Republic in the post-covid period and to propose ways to improve the current state. In order to achieve the goal, it is necessary to examine the current situation of traffic service on the given railway lines between the Slovak Republic and the Czech Republic, the utilization of train connections used for existing transport. Based on the findings of these facts, certain proposals will be presented that should lead to the improvement of traffic operations and increase the efficiency of passenger transportation.

1. Impacts of the COVID-19 pandemic on railway transport between Slovak and Czech Republic

People's behaviour has been changed substantially in almost all aspects of life due to the profound social upheaval brought about by the COVID-19 pandemic that broke out in early 2020. The risk of catching COVID-19 has been reduced across all modes of public passenger transportation over the course of several days (Gkiotsalitis, K., Cats, O., 2021; Böcker et al., 2023).

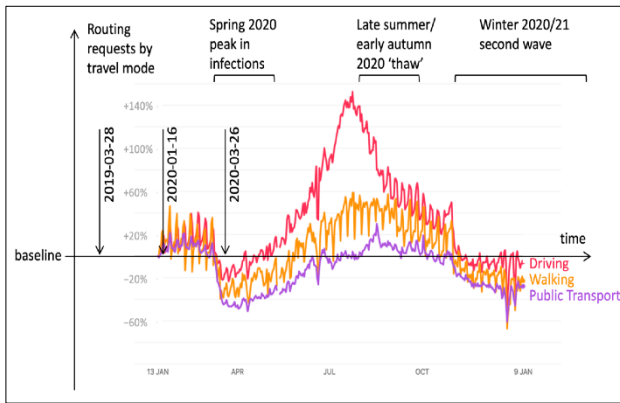


Fig. 1. Mobility changes in particular parts of world after the pandemic outbreak (Toger, M. et al., 2021).

Figure 1 makes the shift in mobility the clearest. After the COVID-19 pandemic outbreak, specific graphs show its significant mobility decline in the world. In the Slovak and Czech Republic, for instance, there have been considerable declines in passenger transport performance and mobility, particularly in the years 2020 and 2021.

2. Border crossings between Slovak and the Czech Republic

The Slovak and the Czech Republic have been part of the Schengen area since December 21, 2007. From 1993 to 2007, border controls were carried out between the Czech Republic, Slovakia, Poland and Hungary. Slovak Republic is located on the external border of the EU, i.e. that border controls are carried out at state borders only with Ukraine.

Currently, there are 7 railway and 17 road crossings between Slovakia and the Czech Republic. All these border crossings are shown in Figure 2.



Fig. 2. Border crossings between Slovak and the Czech Republic

There we can see that the railway border crossings are marked in dark red. Road border crossings are shown in blue. There are all current railway border crossings between the Slovak Republic and the Czech Republic. There are 7 border crossings in total. However, not all of them have passenger transport.

Table 1. Railway border crossing between the Slovak and the Czech Republic

Railway line number	Border crossing
110	Kúty – Lanžhot
114	Skalica – Sudoměřice
115	Holíč - Hodonín
121	Vrbovce – Velká nad Veličkou
123	Horné Srnie – Brumov-Bylnice
125	Lúky pod Makytou – Horní Lideč
127	Čadca – Mosty u Jablunkova

3. Analysis of the development of traffic service on railway lines between Slovakia and the Czech Republic

The mentioned chapter deals with a detailed analysis of railway passenger transport at individual border crossings between the Slovak Republic and the Czech Republic. Important elements that help in the aforementioned analysis are mainly the range of transport services provided by individual carriers on the given routes. In the next part, the frequencies of transported passengers who were in the train when crossing the border are analyzed and described. The aforementioned analysis is carried out in such a way that it compares the scope of traffic service of train traffic diagram periods from the years 2004/2005, 2009/2010, 2015/2016 and the current period 2022/2023.

The most frequented railway line can include line no. 110 Kúty - Břeclav. The range of traffic service on this line is shown in figure 3. For the first three monitored periods, the number of train pairs did not change significantly. In 2009/2010, three pairs of passenger trains were added, which were subsequently cancelled in the following period. From 2020/2021, the carrier RegioJet, a. s. started operating between the Czech Republic and the Slovak Republic on this railway line. With the number of five pairs of train connections on a daily basis, it increased the passenger transport capacity. However, trains of the lower passenger trains category did not run as far as the Czech Republic, which caused a decrease in the number of train connections on this line. Currently, passenger trains category only run on the Kúty - Brodské line due to lockout activity (Tan, L., & Ma, C. 2020).

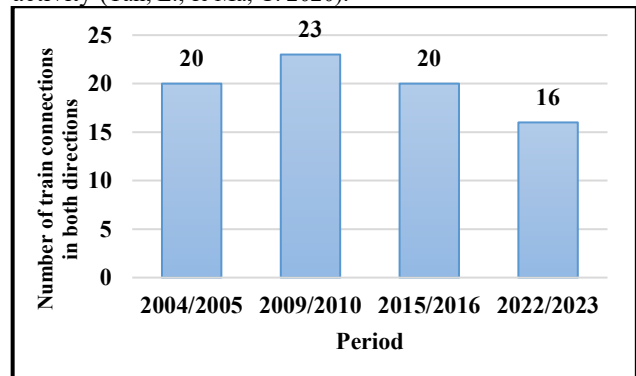


Fig. 3. Comparison of the number of train connections pairs in selected periods on railway line 110

The scope of international traffic service is decreasing on railway line 123. It was caused by a decrease of passenger trains category, which ran in 2 pairs in 2015/2016, and 1 pair of Arriva trains on the route Prague - Trenčín (Nitra), which ran on weekends and later daily (from 2016/2017). After the pandemic in 2020, Arriva did not resume the operation of its trains on this line.

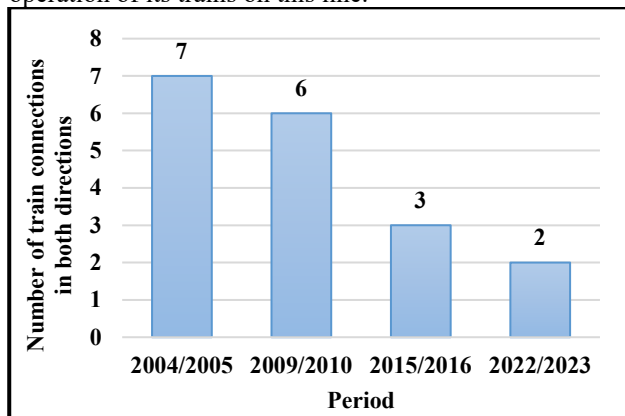


Fig. 4. Comparison of the number of pairs of train connections in selected periods on railway line 123

On the railway line 125 the category of passenger trains no longer continued across the state border, but began and ended their journey at the Strelenka stop in the current train traffic diagram period. The "Valašský express" line covers long-distance transport on this route. There has been added a new connection for both directions of Valašský express EC 222 (6:02 from Púchov) and EC 223 (21:34 from Horní Lideč). They will run from Prague to Púchov or, in one case, continue to Žilina (EC 222 and 221). Changes in the individual number of pairs on this track can be seen on the graph, how they changed during this period. Due to the fact that lower passenger trains were cancelled, this caused a downward trend on this line.

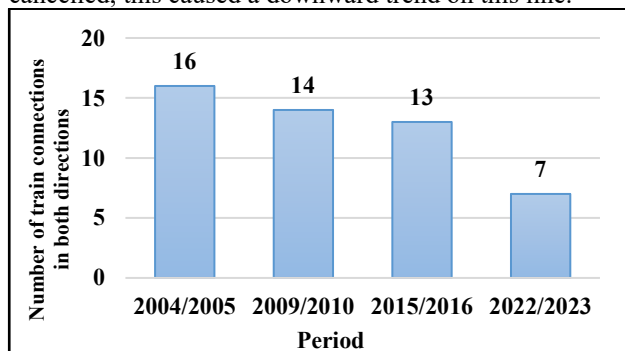


Fig. 5. Comparison of the number of pairs of train connections in selected periods on railway line 125

The number of trains on railway line 121 has not changed significantly over other years. However, in the past and now, only passenger trains run on this railway line.

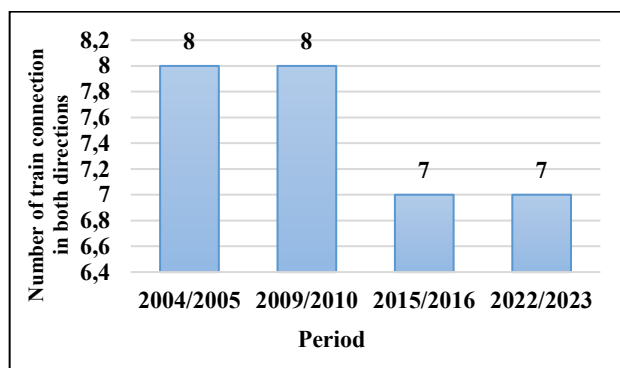


Fig. 6. Comparison of the number of pairs of train connections in selected periods on railway line 121

Changes in the number of pairs of train connections on line 127 can be seen in the figure 7. The graph shows the development of the number of pairs of train connections for individual monitored periods from 2004/2005 to the current period. For the first three periods, the numbers of pairs of train runs did not change much. In 2015/2016, the number of connections increased due to the entry of private carriers RegioJet, a. s. and later Leo Express, which started operating between the Czech Republic and the Slovak Republic. Currently, passenger trains are not running on the Čadca - Mosty u Jablunkova railway line due to road closure works, which caused a lower number of connections in the current train traffic diagram period.

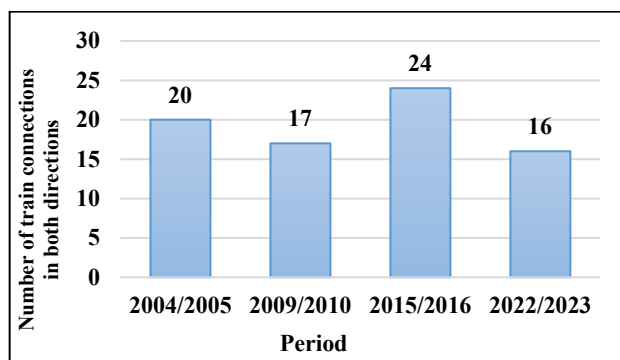


Fig. 7. Comparison of the number of pairs of train connections in selected periods on railway line 127

Currently, a total of 48 train connections pairs operate between the Czech Republic and the Slovak Republic. Up to 33,3% of train pairs run on the railway line no. 110 (Bratislava – Kúty – Břeclav) and also up to 33,3% of train pairs run on the railway line no. 127 (Žilina – Čadca – Mosty u Jablunkova). There are only 2 passenger trains are currently running, namely 1 pair on Fridays and the other pair on Sundays on the railway line no.123. Routes 121 and 125 have 7 pairs of trains. International passenger rail transport is currently suspended on railway lines no. 114 and 115. The display of the current status for the year 2022/2023 is shown in figure 8.

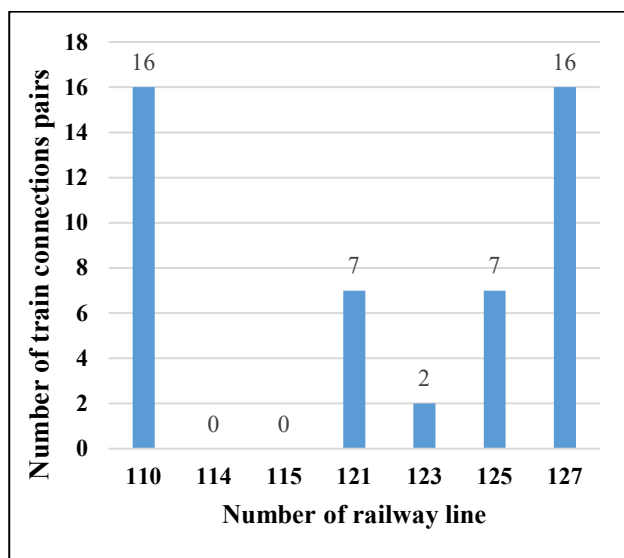


Fig. 8. Comparison of the number of train connections pairs in selected periods on railway line 121

3. Brief analysis of passenger frequencies on the railway lines between Slovak and the Czech Republic

Currently, the highest frequency of rail passenger traffic at these border crossings in the monitored period was recorded on the railway line Bratislava – Kúty – Lanžhot. On average, almost 3 times more passengers were transported on this line than on the second most frequented line no. 125. According to published data on the railway line no. 127, the number is low due to the low utilization of the capacity of passenger trains connections. In the current schedule, passenger trains on this line have been cancelled, leaving only 1 pair in the morning hours. Passenger traffic has been suspended on line 115 since 2004, and no cross-border connections to the Czech Republic have been running on line 114 since 2008. There are currently 2 pairs of trains running on line 123, one on Friday and the other on Sunday, and according to the data, they are not among the most frequented. What the frequency situation looks like during the observed period from October 17 to 23 is shown in figure 9. There is average amount for one train connection in each railway line (blue colour – even direction, orange colour – odd direction) (ZSSK, 2023).

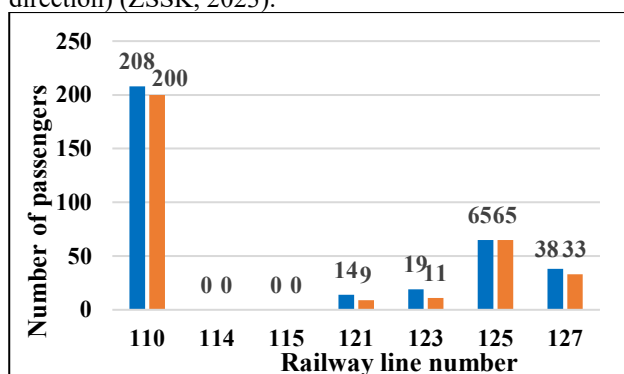


Fig. 9. Comparison of the passenger frequencies on the particular railway border crossings (ZSSK, 2023).

4. Proposal of traffic service development between Slovak and the Czech Republic

Based on the monitored analysis of traffic service and passenger frequencies on the particular railway lines between Slovakia and the Czech Republic, the following 5 solution options were proposed to improve the current situation on the given line sections. These are preliminary framework proposals that could be assessed by those ordering passenger rail transport, as well as by specific carriers, as to whether they would be suitable for implementation in the near future (Gašparík, J. et al, 2018).

4.1. Proposal of the traffic service on 110 railway line

A priority option that could improve the current traffic service provided by passenger transport on the given line could be the introduction of additional pairs of EuroCity (EC) train connections and the introduction of a night train (EN) for international transport. Trains of this category could thus operate on the section Bratislava – Brno – Prague and back at specified time positions during the day. Due to the relatively high frequency of passengers, the railway line has a high potential. Such connections could help to make use of this line every hour and thus attract more passengers for a longer transport distance, since there is a relatively large interest in traveling on it for the purpose of work, education and tourism. Train connections would be introduced in time intervals when no train is currently running, e.g.:

- 7.06 a.m. EC train departure from Bratislava or ideally around 7 a.m. arriving in Prague at 11:37 a.m.
- 5.06 p. m. EC train departure from Bratislava via Brno to Prague 21:37,
- 9.06 p. m. EC train from Bratislava to Prague 01:37,
- introduction of the EN train that used to run on this line (until 2015/2016) with a potential continuation to Hamburg with a stop in Berlin.

The second proposal could also be considered the introduction of trains at the same time positions, when there are gaps in the beat. These would be trains that would be introduced on this line and would serve as a direct connection by accelerated trains (REX) to the RailJet trains that run from Vienna to Prague. The transfer would be ensured in the following cases (in the case of EC, the drive to Břeclav takes 56 minutes):

- RJ 70 on the route Vienna – Prague via Břeclav, where the train stops from 8:04 a.m. until departure at 8:06 a.m.,
- RJ 370 Vienna – Prague via Břeclav, where there is a train connection from 18:04 until departure at 18:06,

In these two cases, it can be considered that when changing from the REX connection to the RailJet connection on the route Břeclav - Prague, there are only 2 direct ones. In the case of the last possible train ride at 21:06, there is no direct connection from Břeclav station that would connect the route to Prague railway station.

New possible time positions of train connections on the railway line Prague – Brno – Bratislava should be as follows:

- 8.24 a. m. EC train Prague – Bratislava 12.54 p. m.,
- 6.24 p.m. EC train Prague – Bratislava 10.54 p. m.,
- 7.24 p.m. EC train Prague – Bratislava 11:54 p. m. ,
- 8.24 p. m. EC train Prague – Bratislava 00:54 a. m.,
- the introduction of a night train (EN) possibly at night.

Given the situation that there is no connection from Prague after 5:24 p.m., these trains could help passengers to schedule train connections more comfortably. All these changes would mean an increase in the number of sets, which are inevitable when the number of connections is increased (Fľašík, 2023).

4.2. Proposal of the traffic service on 115 railway line

Another way to improve the quality of traffic service between Slovakia and the Czech Republic could be the introduction of accelerated trains (REX) on the route Bratislava – Kúty – Holíč – Hodonín and back. In the specified time positions, or in a two-hour cycle per day, they could thus fill the capacity of the no-longer-used line for passenger rail transport. Considering the high load on the railway line no. 110 this line could also have some potential. Another possible variant on the above-mentioned line could be the assessment of the extension of lower-category passenger trains, which currently run on the Zaječí - Hodonín line. As part of the proposal, it is possible to extend them up to Holíč nad Moravou. These connections could have a good tourist potential considering the wine village of Zaječí, which is popular (Fľašík, 2023).

4.3. Proposal of the traffic service on 114 and 121 railway line

A proposal to improve the situation on the railway lines no. 114 and 121 through rail passenger transport could be the introduction of Regional express trains (REX). At the designated times during the day, trains of this category would operate in 2 pairs on the route Trenčín – Nové Mesto nad Váhom – Vrbovce – Veselí nad Moravou – Brno in combination with line 114. Such connections could help to make use of this line every hour and thus attract more passengers for a longer transport distance, as this part of Slovakia is currently not connected by train connections from Záhorie region. Train connections would be introduced in time intervals when no train is running.

The first REX connection could run around 7-8 a. m. in the morning on the transport route Trenčín – Nové Mesto nad Váhom – Vrbovce – Veselí nad Moravou – Brno. In the combination of the passenger trains from the direction of Kúty – Skalica – Sudoměřice, it would help passengers to be able to transfer to the REX trains. However, these changes would also require significant changes in the set circuits in the case of passenger trains category, as well as an increase in the engine units of the REX trains category.

The second connection could operate at around 4-5 p.m., when it could suit most passengers also from the point of view of their working hours. In these hours, it is possible to think about a higher load of train connections

from the point of view of commuting from work, study, or from the point of view of recreational activities.

The connection of these 2 lines with a transfer from the line from the direction of Kúty (route 114) in Veselí nad Moravou could make it easier for passengers living in this area to travel to Brno or Trenčín. In the current situation, they have to travel by lines to Bratislava and from Bratislava to Trenčín. This proposal could eliminate the loss of excessive time in this activity (Fľašík, 2023).

4.4. Proposal of the traffic service on 123 railway line

Another option that could improve the traffic service between the two countries could be the introduction of 2 pairs of REX train connections on line 123, with one pair operating in the morning hours and the other pair in the afternoon hours during peak traffic. Train connections would operate on the route Trenčín - Brno via Horné Srnie - Uherský Brod - Veselí nad Moravou. However, this is a non-electrified track section of the line with a maximum permitted speed of 70 km/h. Since currently only 1 pair of train services operate on the given line on Fridays and Sundays, the mentioned proposal would increase their number as well as the quality of traffic service. Specifically, it concerns the following 2 pairs of trains that could serve as a proposal (the time is only indicative):

- 7.05 a.m. departure from Trenčín via Horné Srnie – Uherský Brod – Veselí nad Moravou – Brno,
- 4.35 p.m. departure from Trenčín via Horné Srnie – Uherský Brod – Veselí nad Moravou – Brno.

In the opposite direction, individual connections could operate at approximately the same time positions (Fľašík, 2023).

Currently, there are only direct buses between these cities. The first bus service from Trenčín departs at 7:45 a.m. (Flixbus) on this section. The second bus service of the same carrier, which moves in the same time positions, leaving Trenčín in the afternoon at 1:35 p.m.

In the opposite direction, Brno – Trenčín, there are 3 direct bus connections at the following times:

- 9.10 a. m. Flixbus, Brno – Trenčín,
- 12.30 p. m. Flixbus, Brno – Trenčín,
- 3.40 p. m. kmko logis, p. r. o., Brno – Trenčín (cp.sk, 2023).

4.5. Proposal of the traffic service on 125 railway line

The first possible solution in the proposal for an assessment of the possibility of improving the connection between important cities of the Czech Republic and the Slovak Republic is the possibility of connecting Púchov and Brno. Currently, only interstate trains connecting Púchov and Prague operate on this line, but in the case of traveling to Brno, it is necessary to take a train to Bratislava or Žilina, or use transfers at railway station Hranice na Moravě. This proposal would partially eliminate the loss of time for passengers. By deploying new connections on a daily basis in the morning hours (EC category) and possibly also in the night hours (EN category), inefficient commuting to work in Brno from the

regions of central and eastern Slovakia could be at least partially eliminated. Specific proposals could be as follows:

- EC with departure at 10:00 from Košice on the route Žilina – Púchov – Horní Lideč – Přerov – Brno
- EN with departure at 10.30 p. m. from Košice on the route Žilina – Púchov – Horní Lideč – Přerov – Brno

The time is only indicative and there are currently no connections connecting routes 121, 123 and 125 from Záhorie region in Slovakia. The situation is such that all trains on these lines run as far as the border crossing station from the Czech Republic. The exception applies to the line no. 125 line, where connections run from Púchov to Prague in the number of 5 pairs and 2 pairs directly from Žilina.

Return journeys from Prague or Brno could look like this. For example train from Brno could operate in the morning hours as well as the EC from the direction of Košice – Púchov – Brno, or in the afternoon hours around 1-2 p. m (Luthi, M., 2007).

The second option for solving the proposal for an assessment of how to improve travel between these two neighbouring states is the introduction of a night train from Prague. railway station. The last train passes PPS at 7:04 p.m., there are no more trains after this connection. Currently, all connections are relatively busy and in the analysis they were among the most frequented beyond line 110. The last lines that currently connect Prague with Púchov have the highest frequency among the other connections. The introduction of a night connection on this line could also be an interesting solution. However, the introduction of all these changes would mean an increase in the number of sets that are necessary for the mentioned changes (Fľašík, 2023).

4.6. Proposal of the traffic service on 127 railway line

In the current train traffic diagram period, train connections were systematized, when long-distance connections began to run every two hours, which were supplemented by SC category trains, as well as Leo Expres and Regiojet carriers. However, only 1 pair of low-category trains (Os) has been preserved, which runs in the morning to Ostrava, leaving Čadca at 4:30 a.m. and back to Čadca, arriving at 11:01 p.m. In the future, it would certainly be advisable to re-introduce at least a two-hour clock of passenger trains that could run daily through the mentioned border crossing (Fľašík, 2023).

Conclusion

The aim of the contribution was to analyse the current state and development of transport staff in international rail passenger transport between Slovakia and the Czech Republic in the post-covid period and to propose ways to improve the current state. According to the given analysis, there were proposed options for improving the transport operation on the monitored railway lines so that it is competitive with other types of transport (especially with respect to bus and individual car transport).

The situation was worsened by the pandemic at the beginning of 2020, specifically in the spring, when the borders were closed. After the re-introduction of passenger train transport between the territories of the Czech Republic and the Slovak Republic, passenger frequencies decreased. In 2022, the situation was improving, but it is necessary to offer passengers new and more attractive ones so that they are better in the current post-pandemic period of passenger frequencies (Naveen, B.R., Gurtoo, A. 2022).

Firstly there are described border crossing between Slovak and Czech Republic, secondly there is analysis of railway passenger transport on the monitored railway lines, namely the analysis of train traffic service for the specified periods, including the determination of the number of connections and their changes and subsequently the frequency of passengers at these border crossings, which were provided by the national carrier ZSSK a. s. for the period from October 17 to 23.

Finally based on the analysis in the second chapter, there were proposed 5 options for improving the current situation in international rail passenger transport. The advantages of these proposals are the improvement of traffic service on the lines that connect the two states. The connectivity of the regions, especially South Moravian Region and Záhorie would also be improved. The disadvantages of the mentioned proposals are the fact that for their implementation it is necessary to ensure a higher number of train sets and it is also necessary to consider the increase of individual costs for the operation of the proposed range of transport.

Acknowledgment

This publication was created thanks to support under the Operational Program Integrated Infrastructure for the project: Identification and possibilities of implementation of new technological measures in transport to achieve safe mobility during a pandemic caused by COVID-19 (ITMS code: 313011AUX5), co-financed by the European Regional Development Fund.

References

- Böcker, L., Olsson, L.E., Priya Uteng, T., Friman, M., 2023. Pandemic impacts on public transport safety and stress perceptions in Nordic cities. *Transportation Research Part D: Transport and Environment*, 114, 103562. <https://doi.org/10.1016/j.trd.2022.103562>
- cp.sk – website about timetables of public passenger transport, available online: www.cp.sk
- Fľašík, L., Possibilities for the development of international rail passenger transport between the Slovak and Czech Republic in the post-covid period. Bachelor's Thesis, University of Žilina, Žilina, Slovakia, 2023.
- Gašparík, J. et al., Research on Dependences of Railway Infrastructure Capacity, In: *Tehnicki vjesnik-technical gazette*, Volume 25, Issue 4, 2018, pp. 1190 – 1195, 2018, 10.17559/TV-2016091719224
- Gkiotsalitis, K., & Cats, O. 2021 Public transport planning adaption under the COVID-19 pandemic crisis: literature review of research needs and directions. In: *Transport*

- Reviews [online], pp. 1-19. ISSN 0144-1647. Available: <https://doi.org/10.1080/01441647.2020.1857886>
- Luthi, M.: The Train Departure Process and its Impact on the Rail Network Performance, In: 7th Swiss Transport Research Conference, 20 pp., 2007. Available online: http://www.strc.ch/2007/2007_johner.pdf.
- Naveen, B.R. & Gurtoo, A. 2022 Public transport strategy and epidemic prevention framework in the Context of Covid-19. In: Transport Policy, Vol. 116 (2022), pp. 165-174. Available: <https://doi.org/10.1016/j.tranpol.2021.12.005>
- Slovak Republic, 2020 The impact of COVID-19 on the development of railway transport in Slovakia in 2020 compared to 2019, Transport Authority, p. 7. Available: <http://drahy.nsaf.sk/wpcontent/uploads/sites/3/2021/07/C-OVID-monitorovacia-spr%C3%A1va-2020.pdf> [Accessed 26 April 2022].
- Tan, L., & Ma, C. 2020. Choice behaviour of commuters' rail transit mode during the COVID-19 pandemic based on logistic model Journal of Traffic and Transportation Engineering, Vol. 8 (2), (2020), pp. 186-195, Available: <https://doi.org/10.1016/j.jtte.2020.07.002>
- Toger, M., Kourtit, K., Nijkamp, P., & Öst, J. 2021. Mobility during the Covid-19 pandemic: A data-driven time-geographic analysis of health-induced mobility changes. Sustainability, 13(7), 4027.
- ZSSK, 2023, Internal materials.