

COMPARISON OF TRANSPORT SERVICES PLAN ON THE LINE KOŠICE – PREŠOV – PLAVEČ – (MUSZYNA)

Abstract. The operation of railway passenger transport is characterized by high economic costs and also high requirements for personnel and vehicle means. Existing rail transport operators aim to provide transport services as modern, efficient and cost-effective as possible, while meeting all safety and quality standards. In the case of public service obligations, they must also respect the requirements of the contracts. Currently, a significant transformation of the railway passenger transport operation throughout Slovakia is being prepared in order to increase its efficiency, sustainability and quality. This primarily concerns public service obligations. The line Košice - Prešov - Lipany - Plaveč - (Muszyna) (line No 188) will also be affected. Transport services on this line will be significantly modified and intensified, inter alia, because of the introduction of an integrated transport system in the relevant region. The Route 188 service plans were prepared in two different Transport Service Plans (TSPs). The first one was prepared by the Prešov and Košice Regions. In parallel with the first TSP, a second TSP was prepared by the Ministry of Transport and Construction of the Slovak Republic (MT&C SR) for the entire Slovak railway network, which also includes line No 188. There are several differences in the proposals included in TSPs for the line in question. The main objective of this paper is to compare the traffic service proposals in the individual TSPs developed for Line No. 188 based on a comparison with the status quo and a comparison of selected operational indicators, as well as to determine the basic advantages and disadvantages.

Keywords: transport service plan, railway passenger transport, public service obligation

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Introduction

The operation of the railway passenger transport on the line Košice - Prešov - Lipany - Plaveč and Muszyna started in the second half of the 19th century. Since then, a large number of changes have been implemented on this line, both in terms of the transport availability (TA) and of the railway infrastructure. The line has gradually become one of the most important lines from whole network in Slovakia also because it connects the 2 largest towns in the eastern Slovakia region, to/from which it enables the collection and distribution of passengers to/from the surrounding area, and also transport between them. PSK studies have shown that the current state of TA on the line is not sufficient and adequate to satisfy future objectives of regional policy. (Ministerstvo dopravy, 2022; PDO PSK, 2021; Pribula, 2022).

As a result of the implementation of the integrated transport system (ITS) and efforts to increase the efficiency of the railway transport in the Slovak Republic (SR), transport service plans have been created. The previously published TSP, which also addressed the issue of line 188, was prepared by the Prešov and Košice Regions (P/KR), which monitored the improvement of public transport in Eastern Slovakia with a plan to introduce an ITS. The second, later published TSP was prepared by MT&C SR, which addressed the issue of optimising the overall public services obligation in railway transport, preparation for planned transport public tenders and efficient spending of public resources on performance in the railway passenger transport (Eisler, 2014;

Poliaková, Gogola, 2020; Nedeliaková, et. al., 2007; Pribula, 2020; IDS-Východ.sk, 2020).

The main goal of this article is first of all to characterise the line section Košice - Prešov - Plaveč - (Muszyna) and then to characterise and compare the presented transport availability proposals, respectively TSPs for line No. 188 on the basis of a comparison with the state of art, by using selected operational indicators and identifying their main advantages and disadvantages.

1. Characterization of the relevant region and railway line

The line section Košice - Prešov - Lipany - Plaveč - Muszyna is located in the eastern part of Slovakia, specifically it covers the districts of Košice, Prešov, Sabinov and Stará Ľubovňa. The line designation according to the Table of Line Ratios (ToLR) is 107A with the official start at the Kysak hub station due to the fact that the Košice - Kysak section of line No 188 is shared with line No 180 (according to ToLR 105A). It is a 1st category international line of major importance for both

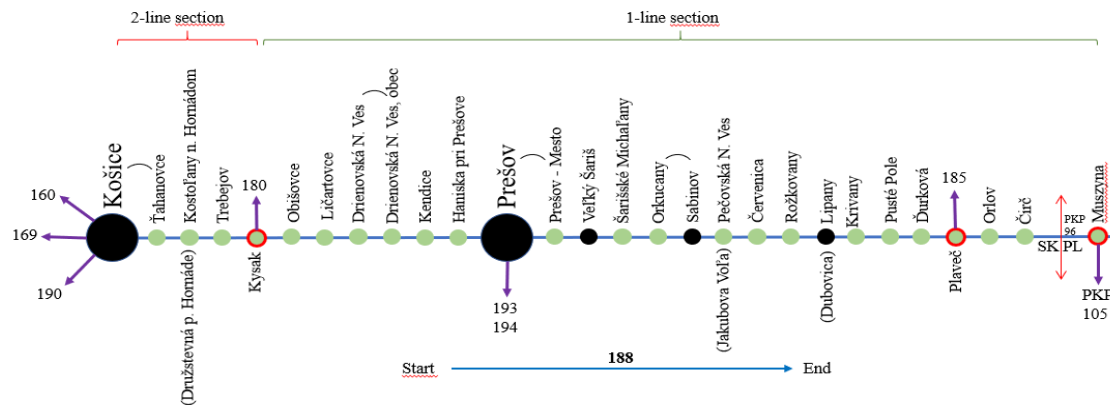


Fig. 1. Railway line No 188 (Source: Authors)

passenger and freight transport, it is part of the international corridors AGC, RFC 11 and AGTC. The line is electrified throughout its entire section with direct current at a voltage of 3000 volts and line is predominantly single-track. The Figure 1 shows the alignment of the line No 188, with the individual serviced settlements, the branch lines, the routing of the line, etc. (PDO PSK, 2021; PDO PSK, 2022; Pribula, 2022).

The line connects 26 settlements to each other, of which two are regional cities (big black dots). In addition to these regional cities, there are also other, so-called "smaller towns" on the line, in particular Sabinov, Veľký Šariš and Lipany (small black dots). Some of these settlements are not directly municipalities that have their own tariff point on the line, but there is a stop or station of another municipality in their accessible vicinity, e.g. Družstevná pri Hornáde -> Kostolany pri Hornáde (the name of this settlement is in brackets). Orkucany is the part of Sabinov, or Ťahanovce is the part of Košice. The purple arrows represent the outgoing lines, by the way the line starts in Košice / Kysak and ends in Muszyna, town in Poland, or at the border crossing Čirč - Muszyna (Černá 2018; PDO PSK, 2021; Pribula, 2022).

The following combined graph (Fig. 2) shows the population in area of the mentioned railway line and the average daily number of the transported passengers on it, within the period 2013-2021.

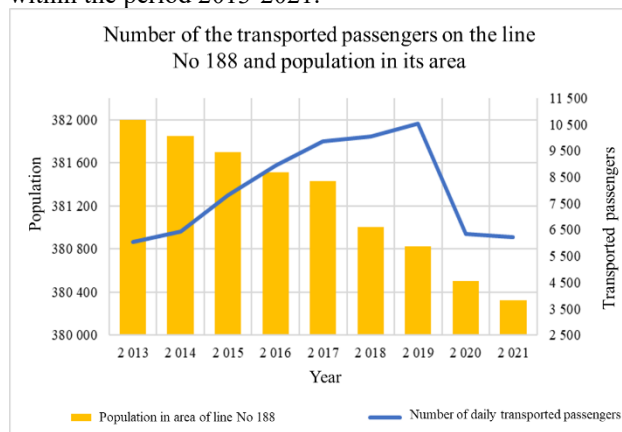


Fig. 2. Transported passengers on the line 188 and population in its area (Source: Authors)

The total population of settlements in area of the line No 188 was approximately 380,000 inhabitants in 2021, but this number is decreasing year by year (see Fig. 2 - yellow bars), nevertheless the number of passengers carried by regional trains on the line in question has been increasing until 2019 (see Fig. 2 - blue line). Since this year there has been a noticeable decrease in the number of transported passengers, mainly due to the outbreak of the COVID-19 pandemic, but at present the demand for transportation on this line seems to be returning to normal, but this is an expert estimate based on observation in real conditions. The implementation of ITS should also contribute to a significant increase of demand for transport in the future, while rail transport in this region should form a backbone network with a high-capacity character (Ministerstvo dopravy, 2022; Pribula, 2022).

2. Characteristics of the state of art and proposals for transport availability

In order to define and characterise the proposed changes and differences, it is also necessary to characterise the actual form of TA. After the description of the state of art, it will be possible to identify all the proposed changes in general and then in specific details for each existing PDOs. The following figure (Fig. 3) characterizes the sections of line No 188 to be served in three forms, respectively variants.

The first figure (A) represents the current state of TA, the second figure (B) the proposal or a variant in the TSP compiled by P/KSK and the third figure (C) the proposal or variant in the TSP compiled by MT&C SR. These figures will form the basis for the following subchapters

2.1. Current state of TA on the line NO 188

Currently, the railway line No 188 is mostly operated by regional public transport, namely trains of the category "Commuter train" (Os) and the category of rapid train "Regional Express train" (REX). The operation of these trains is illustrated in figure 3A.

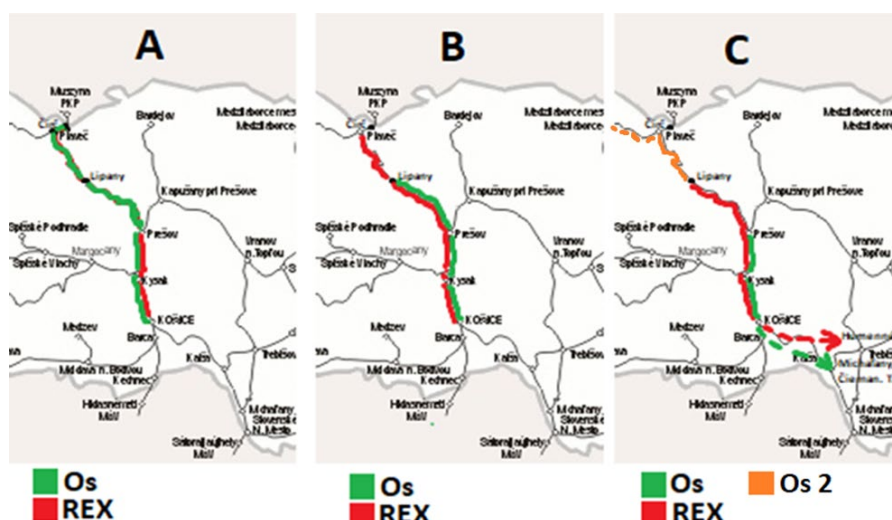


Fig. 3. variants of TA on the line No 188, (Source: Authors)

Trains of category Os (green) are operated daily on the section Košice/(Kysak) - (Prešov)/Lipany, while on selected days, usually Fridays and Sundays, these trains continue up to the Čirč stop. During peak hours, the axle trains are complemented by several REX trains (red), which serve the Košice - Prešov section and stop in the Kysak station. These connections increase the offer of transport services and will also allow faster passenger transportation between regional cities (PDO PSK 2022; Ministerstvo dopravy, 2022).

The operational performance of these trains is approximately 803 000 train-km/year with approximately 19 connections per day. The service is provided by various vehicles, for example: electric multiple units (EMU) 671+971, EMJ 460, EMJ660, EMJ 661, or trainsets 1XX+4/5B, etc. In addition to the above-mentioned trains, there are other train connections on the line, such as the booster fast train "Šarišan", seasonal, recreational and tourist trains, the daily fast train 9XX "Poľana" and the commercial international train "LeoExpress" (Pribulu, 2022).

2.2. The general changes of TA on the line 188

The most significant change affecting both TA proposals is its significant empowerment. An integrated timetable will be introduced on the line with zonal service via REX and Os trains. REX trains will operate on a regular basis and will be the high-capacity connection on the line No 188. This means that the Os train connections will no longer be supplemented by REX trains connections, but vice versa. Also, REX lines will operate on most of the line length, not only on the Košice - Prešov section, and they will be connected or connecting to fast trains R6XX, express trains IC and other trains in the Kysak hub station (Pribula, 2022).

In both cases, it is also planned to unify or change the train means or the type of used vehicles. It can be expected

that the lines will be given their own designations after the implementation of ITS, for example R30 - REX or S30 - Os. It is also expected to reduce the number of parallel journeys or to optimise and coordinate the connections with the suburban bus services (PDO PSK, 2022).

2.3. Proposal of TA created by P/KR and MT&C SR

Specific plans in the proposal prepared by P/KR:

- Line Os operates the section Košice - Prešov - (Lipany), line REX operates the section Košice - Plaveč (Fig. 3 B);
- Selected connections of line Os will start or end in Kysak and selected REX connections will operate only the section Košice - Prešov;
- Line Os - 20 connections per working day and 15 connections per weekend; Line REX - 24 connections per working day and 16 connections per weekend;
- Extension of the operation of the section Lipany - Plaveč (Thursday + Saturday), cancellation of the operation of the section Plaveč - Čirč and stops Pusté Pole and Ďurková;
- Service by EMU 671+971 and their need will be 8 vehicles (PDO PSK, 2021; PDO PSK, 2022).

Specific plans in the proposal prepared by MT&C SR:

- Line Os operates on the section Košice - Prešov, line REX operates on the section Košice - Lipany (Fig. 3 C);
- Selected connections of the REX line serve only on the section Košice - Prešov;
- Os line - 15 pairs of connections per working day and 10 pairs per weekend, REX line - 19 pairs of connections per working day and 18 pairs per weekend;
- Operation of the section Lipany - Plaveč by means of a separate diesel train connection "Os 2", which will operate Lipany - Plaveč - (Stará Ľubovňa) and cancellation of the operation of the section Plaveč - Čirč;

Table 1. Transport indicators of 3 variants of the operation on the line No 188 (Source.: Authors)

A - State of art	Type of train	Interval of train [min]	Average operational performance per day [train-km/day]	Average operational performance per year [train-km/year]	Average vehicle capacity [seat-places]	Transport performance [seat-km]
	REX	~60	264	64 152	324	20 785 248
	Os	60/120	2 022	737 929	324	239 088 996
	Total	-	2197	802 081	324	259 874 244

B - P/KR TSP	Type of train	Interval of train [min]	Average operational performance per day [train-km/day]	Average operational performance per year [train-km/year]	Average vehicle capacity [seat-places]	Transport performance [seat-km]	Comparison of yearly OP with state of art
	REX	60/120	3 310	1 208 251	307	370 933 057	+94,69 %
	Os	60/120	990	361 328	307	110 927 696	- 104,23 %
	Total	-	4 300	1 569 579	307	481 860 753	+ 48,90 %

C - MT&C SR TSP	Type of train	Interval of train [min]	Average operational performance per day [train-km/day]	Average operational performance per year [train-km/year]	Average vehicle capacity [seat-places]	Transport performance [seat-km]	Comparison of yearly OP with state of art
	REX	60/120	2 032	741 580	289	214 316 620	+ 91,35 %
	Os	60/120	859	313 500	247	77 434 500	- 135,38 %
	Os 2	-	58	4 872	82	399 504	+ 100 %
	Total	-	2891/2949	1 059 952	276	292 150 624	+ 48,90 %

Table 2. Advantages and disadvantages of proposals TA, B & C variant (Source: Author)

Proposal of TA created by P/KR (B)	
Advantages	Disadvantages
Strong increase in TA compared to current situation (by nearly 50%), above-average transport availability	Increasing risk of unfeasibility, high need for train requirements
Reduction of travel time on most transport lines (Lipany - Košice)	Congestion of the railway section
Short transfer time in Kysak station adapted from/to R6XX and others connections (9 - 11 mins)	Spacing between Os and REX lines (Uneven loading of train lines)
Significant extension of the TA on the congested section (Prešov - Lipany)	Average vehicle capacity is lower than at current situation
Operation of the Lipany - Plaveč section also on Saturdays and Sundays	Cancellation of operation of the Plaveč - Čirč section and train stops Pusté Pole and Ďurková
Proposal of TA created by MT&C SR (C)	
Advantages	Disadvantages
Proportional increase in TA compared to the current situation, reducing the risk of unfeasibility	Electrification of the Bánovce nad Ondavou - Humenné section has not begun
Connecting several lines due to make efficient use of train requirements	The average vehicle capacity is lower than at the current situation and in the proposal of the P/KSK
Reduction of travel time on most transport lines (Lipany - Košice)	Long transfer time in Kysak station from/to R6XX and other connections (18-22 mins)
Reduction in the number of transfers (south of Košice)	Spacing between Os and REX lines (Uneven loading of train lines)
To not congesting the railway section	Operation Lipany - Plaveč section by a separate line, without operation of the Plaveč - Čirč section

- Selected connections of line Os will continue to Michalany or Čierna nad Tisou and selected connections of line REX will continue to Humenné, after the electrification of the section Bánovce nad Ondavou - Humenné;

- Operation of Os line connections by EMU 661 and operation of REX connections by EMU 661 and 1XX + 4/6 B, i.e. locomotive + 2nd class carriages. The required number of vehicles is not specified (Ministerstvo dopravy, 2022).

3. The evaluation of TSPS

The previous chapter identified the main differences or changes which are proposed within the addressed TSPs and which differ from each other or from the state of the art. Some changes can be evaluated numerically through

operational indicators such as average vehicle capacity, operational performance (OP) in train-km or transport performance (TP) in seat-km.

Other changes can be evaluated verbally by comparing them in terms of advantages and disadvantages (Dolinayová, et. al., 2015; Pribula, 2022).

3.1. The evaluation of operational indicators

The following table (Tab. 1) shows the values of selected operational indicators (operational, transport performance and average capacity) of all three forms of TA on the line No 188. The first table "A" represents actual TA, the second table "B" represents values based on the P/KR TSP, and the third table "C" represents values based on the MT&C SR TSP. The values of the individual

indicators are divided among the planned lines in the tables, and the total values for the line No 188 are also shown in both of the tables. In both designs (Tab. 1 B and C), there is a noticeable increase in total daily performance. It is also possible to notice the reorganisation of the current transport services so that the majority of the performance will be provided by REX trains. The TA variant of the proposed P/KR is almost 50% higher in operational capacity than the current condition and 32% higher than the MT&C SR proposal. Transport performance is also the highest in variant B. The planned TA in the MT&C SR proposal is approximately 25% higher than the current condition. The highest average vehicle capacity is as calculated in the current condition and the lowest in variant C, therefore the offered TP is only 12% higher despite the 25% higher OP compared to variant A.

3.2. The characterisation of the advantages and disadvantages

In order to get a good idea of the planned changes in the TSPs compiled by the two different stakeholders, it is also useful to identify their most significant advantages and disadvantages. The particular advantages (green column) and disadvantages (red column) of the TA proposals on the line No 188 can be seen in the table 2 (2 B - TSP P/KR and 2 C - TSP MT&C SR).

The table 2 outlines some of the advantages and disadvantages of the TA proposals created by the P/KSK and the MT&C SR. It will only be possible to confirm if the claims presented in the table are also valid after the implementation of one of the TSPs plans on the line No 188. The most significant advantage of both variants is the increase in TA and faster travel times on selected routes. The most significant disadvantage is the cancellation of the service of some tariff points and the spacing between Os and REX connections of approximately 15/45 minutes in the section Košice - Prešov. This means that insufficient utilisation of connections can be expected, i.e. Os trains will be used mainly by passengers from the municipalities on the section, but these are fewer than passengers travelling between Prešov, Kysak and Košice. Another significant disadvantage in the P/KR TSP is line capacity congestion, due to the TA increase being too extensive, which increases the risk of unsustainability or infeasibility. A prominent disadvantage of the MT&C SR TSP is the long transfer time at Kysak station and this will reduce the quality of transfers (Černá, 2018; Drdla, 2014).

Conclusion

On one of the most congested lines in Eastern Slovakia, a transformation of the way of solving the transport service through rail transport will take place in the near future on the basis of one of the resolved TSPs. Their goals are to increase the quality, speed, efficiency of rail passenger transport and to simplify the implementation of ITS on this line. Both scenarios warrant an increase in availability on the line No 188 in similar, but in certain

parts, different ways. For example, Option B presents strong increases but the lines would not be connected to other lines, Option C presents a more moderate increase but with more connected lines (Pribula, 2022).

However, it is important to assess these proposals in terms of their effectiveness and sustainability, or financial feasibility. Most likely, the TA design on the line 188, which is proposed by the MT&C SR, will be respected from several perspectives. The first aspect is a proportional increase in DO, i.e. 25% compared to 50% in option B, which could be difficult to sustain on a predominantly single-track line (Ministretstvo dopravy, 2022; PDO PSK, 2022; Pribula, 2022). The second aspect is the author of the proposal, in that proposal B is created by the MT&C SR, which is the ordering authority of the performances. The third aspect is cost. In railway passenger transport the main carrier of (high) costs is usually the OP in train-km or axle-km, or TP in seat-km, thus higher OP or TP usually means higher operating costs, of course also higher demands on the train means and staff (Dolinayová, 2015; Eisler, 2004). A higher offer of connections (variant created by P/KR) may increase the demand for transport, but from a certain number of connections the number of passengers transported (from them the revenues) will no longer increase linearly, but the value will stabilize and the transport will be inefficient, i.e. the transport market will be saturated (Nedeliaková, et. al., 2007; Vojtek, et. al., 2019). Therefore, it can be concluded that an proportionate increase in TA will be most efficient and operationally more sustainable than the customer-oriented offer of the TSP option created by P/KR.

References

- Černá L. 2018. Železničná prepravná prevádzka 2. Žilina: EDIS, 2018. 170s. ISBN 978-80-554-1523-9
- Dolinayová, A., Nedeliaková, E. 2015. Controlling v železničnej doprave. Žilinská univerzita, 2015. ISBN 978-80-970419-9-1
- Drdla, P. 2014. Osobní doprava regionálního a nadregionálního významu. Pardubice: Vydavatelství Univerzity Pardubice, 2014. 412s. ISBN 978-80-7395-787-2
- Eisler, J. 2004. Ekonomika dopravních služeb a podnikání v dopravě. Praha: Nakladatelství Oeconomica, 2004. 151s. ISBN 80-245-0772-2
- IDS-Východ.sk. 2022. O projekte IDS [online]. [cit. 24.11.2022]. 2022. Dostupné: <https://ids vychod.sk/o-projekte-ids/>
- Mapy ŽSR. 2022. [online], [cit. 26.11. 2022]. 2021. Dostupné: <http://www.iwan.eu07.pl/jw/zsr/mapy.htm>
- Nariadenie Európskeho parlamentu a Rady (ES) č. 1370/2007 o službách vo verejnom záujme v železničnej a cestnej osobnej doprave, ktorým sa zrušujú nariadenia Rady (EHS) č. 1191/69 a (EHS) č. 1107/70
- Nedeliaková, E., Dolinayová, A., Harmanová, D. 2007. Ekonomika železničnej dopravy. Žilinská univerzita, 2007. ISBN 978-80-8070-781-1
- Optimization of regional transport networks based on a mathematical model of passenger preferences - iopscience. (n.d.). Retrieved November 28, 2022, from <https://iopscience.iop.org/article/10.1088/1742-6596/2131/3/032101>
- Plán dopravnej obslužnosti Košického samosprávneho kraja. 2021. PDO PSK vrátane príloh

- Plán dopravnej obslužnosti pre železničnú osobnú dopravu [online], [cit. 26.11.2022]. 2022. Dostupné: <https://www.mindop.sk/ministerstvo-1/doprava-3/strategia/plan-dopravnej-obslužnosti-pre-zeleznicnu-osobnu-dopravu>
- Plán dopravnej obslužnosti Prešovského samosprávneho kraja časť 1 a 2. 2021. PDO PSK v rátae príloh.
- Poliaková, B., Gogola, M. 2020. Integrované dopravné systémy. Žilina: EDIS, 2020. 212s. ISBN 978-80-554-1629-8
- Pribula, D. 2020. Analýza podmienok verejnej súťaže pri poskytovaní dopravných služieb v rámci výkonov vo verejnom záujme. [Bakalárska práca], Katedra železničnej dopravy Fakulty prevádzky a ekonomiky dopravy a spojov Žilinskej univerzity v Žiline. – Žilina; 2020. 63 s.
- Pribula, D. 2022. Dopady implementácie IDS vo východoslovenskom regióne na železničnú osobnú dopravu na relácii Košice – Prešov – Plaveč. [Diplomová práca], Katedra železničnej dopravy Fakulty prevádzky a ekonomiky dopravy a spojov Žilinskej univerzity v Žiline. – Žilina; 2022. 73 s.
- Štatistický úrad SR. 2022. Databáza Datacube. [online], [cit. 24.11.2022]. 2022. Dostupné: <http://datacube.statistics.sk>
- Vojtek, M., et al. 2019. Je možné železničnú osobnú dopravu financovať efektívnejšie? In: Verejná osobná doprava 2019 [online] : Zborník prednášok z medzinárodnej konferencie. – 1 vyd. – Bratislava: Kongres STUDIO, 2019. – ISBN 978-80-89565-40-5. – s. 24-29.
- Vojtek, M., Kendra, M., Danis, J., & Zitricky, V. (n.d.). Web of science. Retrieved November 28, 2022, from <https://www.webofscience.com/wos/woscc/full-record/WOS:000426430600061>
- Výročná správa ZSSK 2021 [online], [cit. 25.11. 2022]. 2021. Dostupné: <https://www.zssk.sk/o-spolocnosti/vyrocnasprava/>