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WORK PAPER
SINGLE WAGON LOAD TRANSPORT

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Introduction

Shifting freight transport from road to rail is the key opportunity for the European Union to significantly reduce CO_2 emissions and energy consumption - for a better quality of life and greater independence from fossil fuels in Europe. Transporting goods by rail not only causes 9x lower CO_2 emissions compared to lorries, but also requires 6x less energy. While the general volume of transport in the EU is increasing from year to year, the modal share of rail transport continues to fall from its current level of approx. 16% (EU average 2022). The main reason for the low rail modal share is that it is still easier to drive a lorry across Europe than a goods train. The lack of EU-wide harmonisation at operational, technical and regulatory level makes rail more expensive and less flexible than road, which is why customers often opt for road rather than rail.

In order to halt the decline in rail's share and to shift freight from road to rail, it is essential to revitalise, develop and increase single wagonload rail transport. Single wagonload transport (SWL) manages the collection and distribution of individual wagons or wagon groups and thus offers customer-oriented and flexible end-to-end logistics as a CO_2-friendly and energy-efficient alternative to lorries. A sustainable single wagonload network also forms the basis for realising the potential of other freight transport segments, which is why single wagonload transport forms the backbone of strong freight transport.

Although the European Union is united in many areas, it is highly fragmented in terms of rail transport, and despite efforts to achieve interoperability, national borders are real and problematic for rail freight. The European countries, especially those of central and eastern Europe, are small in terms of their territorial size and small in terms of distances, so that the classic advantages of rail transport can be exploited primarily by international traffic. It is therefore essential that the international network of single wagonload traffic is maintained and that this service is available in all EU countries.

1. Trends in single wagonload transport

In many European countries, the transport of goods by means of single wagonloads is a significant and important part of national and at the same time international logistics chains, especially in the industrial sector. Figure 1 shows the share of goods transported through the service of single wagonloads (hereinafter SWL) in selected EU countries.

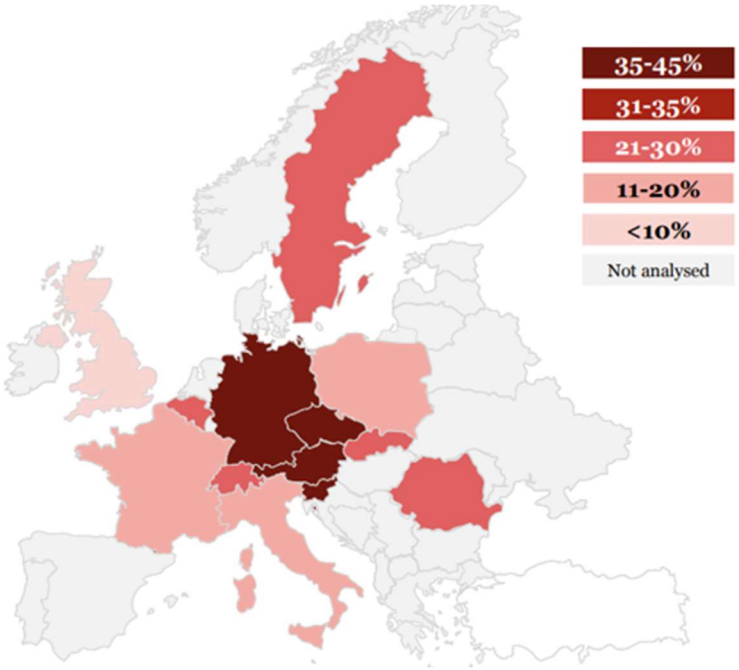


Figure 1: Share of transport of single wagonloads in selected EU countries
Source: European Commission: Study on Single Wagonload Traffic in Europe - challenges, prospects and policy options, 2015

A few railway companies also lost their share in the transport market due to the decline in SWL transport. As part of the competitive struggle, these transports were taken over by road carriers. Therefore, many countries were forced to completely cancel the transport services by single wagonloads or to limit this service of goods transport to a certain extent. Some countries have lost a larger part of their freight revenue by restricting this service. The service of transporting goods by means of single wagonload is most used in the countries of Western Europe (as shown in Figure 2), where the industry is developed and the fees for the use of the railway infrastructure are the lowest.

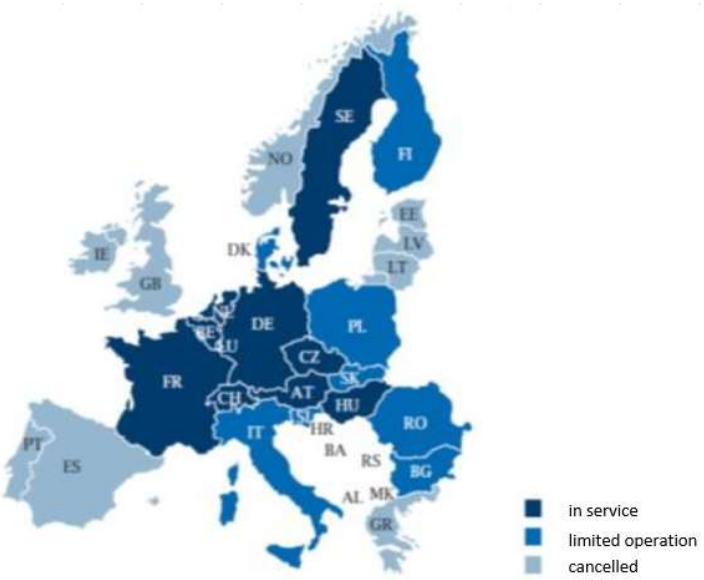


Figure 2: Current state of use of the service of single wagon loads in the EU
Source: Rail Freight Status Report, 2013

Among the main reasons for the cancellation of the SWL transport service, we can include a few factors related to these transports, whether of an economic or operational nature. We can include here:

- high fixed and operating costs in the marshalling yards for serving local service trains in the attraction district,
- low profitability of transport,
- insufficient quality of services provided,
- decrease in the volume of transport on the transport markets,
- construction of logistics centres on "green meadows" without connection to the railway infrastructure,
- restriction of operation or total cancellation of sidings by companies,
- insufficient competition in the segment of transport of single wagonloads.

All these reasons led to the reduction or complete abolition of the system of transport by means of SWL. As part of the support of transport through SWL and the revival of their system, individual carriers must fulfil the requirements of the transport market and, first, the requirements of customers.

1.1. Hungary

The trend in single wagonload transport in Hungary is similar to that in other European countries. Following the liberalisation of the rail freight market (2004), new railway companies entering the market have been organising and operating point-to-point services. The single wagonload service - due to its rather resource- and cost-intensive nature - is provided by the incumbent railway company with nationwide coverage.

The biggest competitor to SWL traffic is road transport. As road can offer much more favourable conditions in terms of both freight rates and quality of service, more and more freight has been and is being diverted from rail to road, and SWL volumes are steadily decreasing.

The Hungarian Government, recognising the danger of the disappearance of single wagonload rail transport and all the negative consequences of this, decided to establish a system of subsidies for single wagonload rail freight transport by Government Decision 1414/2020 (16.VII.). Following approval by the European Commission, the scheme was introduced from the end of October 2021. The introduction of the aid scheme has created the prospect for the survival of this transport segment, which is also important from an environmental, economic and social point of view.

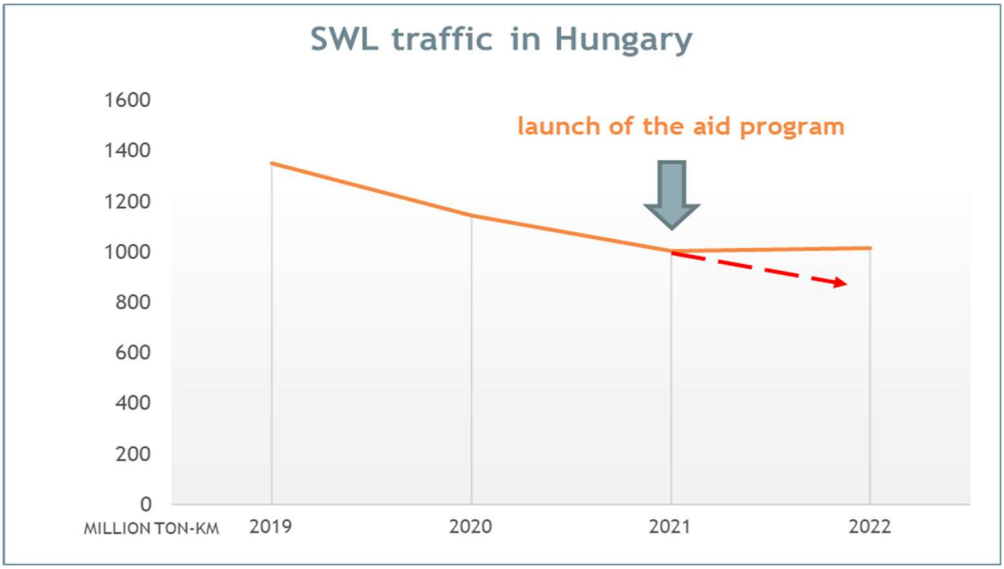


Figure 3: SWL traffic in Hungary
Source: MÁV Zrt.

In 2022, 4.7 million tonnes of goods were transported by rail in Hungary under the single wagonload scheme. 36% of this volume was transported in import traffic and 32-32% in export and domestic traffic. The following graphs illustrate the flows of exports and imports and the main types of goods:

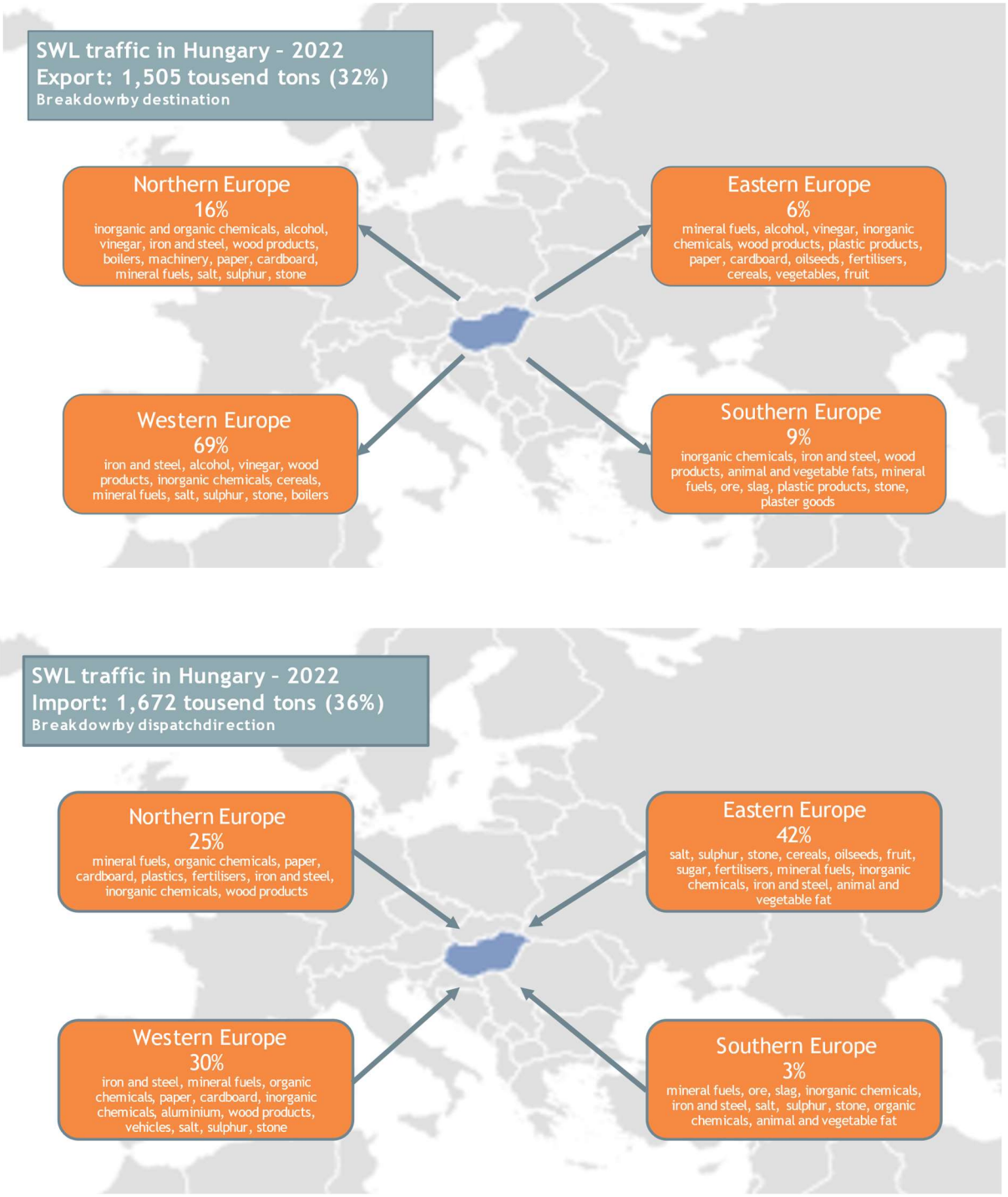


Figure 4: Export and import SWL traffic in Hungary in 2022
Source: MÁV Zrt.

A quarter of the nearly one and a half million tonnes of goods transported domestically were stones, 18.5% were scrap, 15% were lignite, 12% were wood products, 7% were inorganic and 5% were organic chemicals.

1.2. Poland

In 2022, rail transport achieved the second highest result in the last 10 years. The total weight of goods transported was 248.5 million tons (an increase of 2.0% compared to the previous year). The largest amount of cargo was transported in March 2022, which may be related to the outbreak of the conflict in Ukraine, which prompted producers, suppliers and forwarders to adapt to new market conditions.

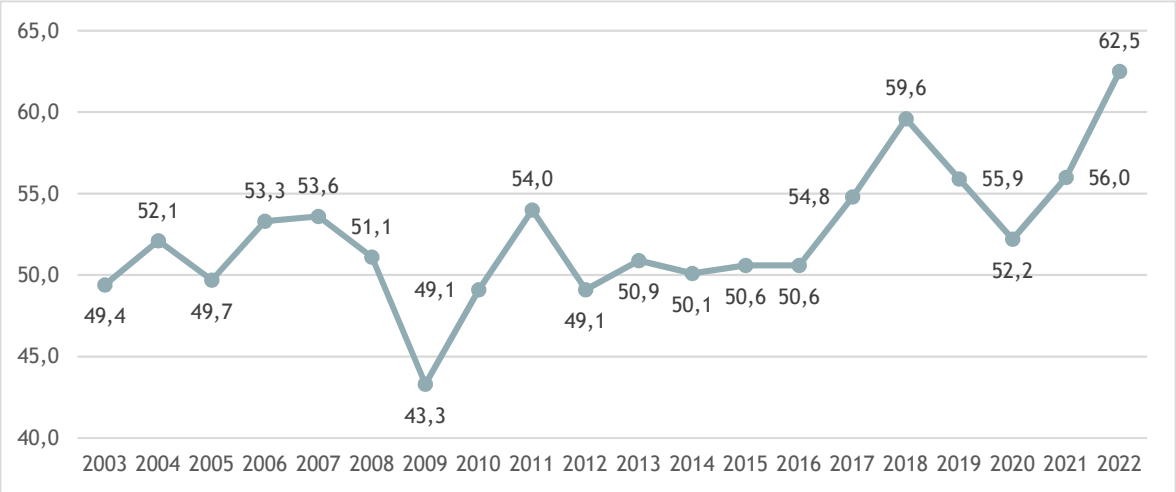


Figure 5: Rail freight transport performance (in billion tonne-km)
Source: Rail Transport Office

The volume of transport performance exceeded 60 billion tonne-kilometers for the first time in over two decades (62.5 billion tonne-kilometers, an increase of 11.7%). This significant increase had an impact on the greater implementation of domestic transport and transport from seaports. The average monthly transport performance was 5.2 billion tonne-kilometers.

Operational performance reached 87.0 million train-kilometer, the second best performance in the past decade. This was a 6.5% increase over the previous year. The average transportation distance of 1 ton of freight was also a record high.

The growth dynamics of this parameter indicates an increased demand for transport and nationwide renovations of railway infrastructure, which extended some routes. The railway sector has recorded significant progress, proving its growing role and efficiency in the transport of goods.

Increased interest in rail freight transport results in developed networks of railway connections. This, in turn, makes it easier and more efficient to single wagonload transport, even in areas that may be difficult to access by other means of transport. Rail freight is often efficient, especially in transporting larger volumes of goods over longer distances. However, single wagonload transport can provide flexibility, especially for businesses that require quick and individual deliveries.

The Polish rail market is dominated by either domestic (PKP Cargo, Lotos Kolej, PKP LHS, Orlen KolTrans) or foreign (DB Cargo) public entities. Freightliner and CTL Logistics dominate among private rail carriers. These are companies with large foreign capital. State-owned enterprises have half of the shares in the railway market, therefore they are the main stakeholder in shipments as owners of appropriate financial and rolling stock resources.

Single wagonload transport especially if requires special handling areas or specialized facilities, can be logistically more complex for smaller carriers. This may discourage them from investing in this type of

transport. If customers of small carriers are not particularly interested in single-car shipments, these companies can focus on providing services that are more in line with current market demand.

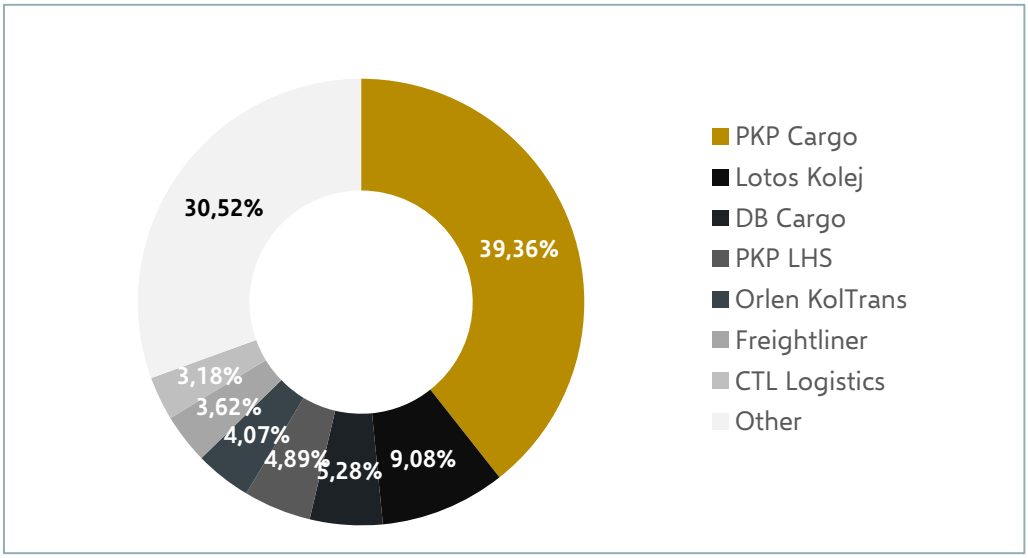


Figure 6: Share of railway carriers in the freight transport market

In 2022, a significant increase in rail freight was recorded, reaching a total freight weight of 248.5 million tons. The freight structure is dominated by energy resources (hard coal - 86.3 million tons). Annual rail freight is also characterized by a noticeable increase in grain shipments. In 2022, the total weight of transported goods increased by 2% (4.9 million tons) compared to the previous year.

The transport performance amounted to 62.5 billion tonne-kilometers, which means an impressive increase of 11.6%. New railway connections, including those directed towards the Polish-Ukrainian border, were one of the factors that influenced this dynamic development, while limiting transport to and from Russia and Belarus.

As in previous years, energy resources, metal ores and aggregates accounted for the largest share of rail freight (one-third of transported goods). Hard coal, oil, natural gas and metal ores were the main components of this category (35.2% of the weight of goods transported in 2022). The second group was metal ores and mining products, accounting for 26% of the weight of goods.

Exceptional freight performance was recorded in the "Agriculture, hunting, forestry, fishing and fishing products" category. In this group, a total of 6.7 million tons of cargo were transported (an increase of 135.9% in relation to the weight of transported goods and 116.7% in relation to the transport performance.)

A particular increase was recorded in the "Cereals" subgroup, where the weight of transported goods increased by 386.5% and transport performance by 335% compared to 2021. It should also be emphasized that the role of railroads in Poland still remains the transportation of energy resources, and 2022 confirmed the potential of the rail sector to flexibly adapt to changing market conditions. In this context, rail transportation is a key branch of freight transport on a national scale.

To summarize, the most popular cargoes transported by rail include fossil fuels, metal ores and mining products, as well as coke, briquettes and refined petroleum products. Less than 12% are unidentifiable goods.

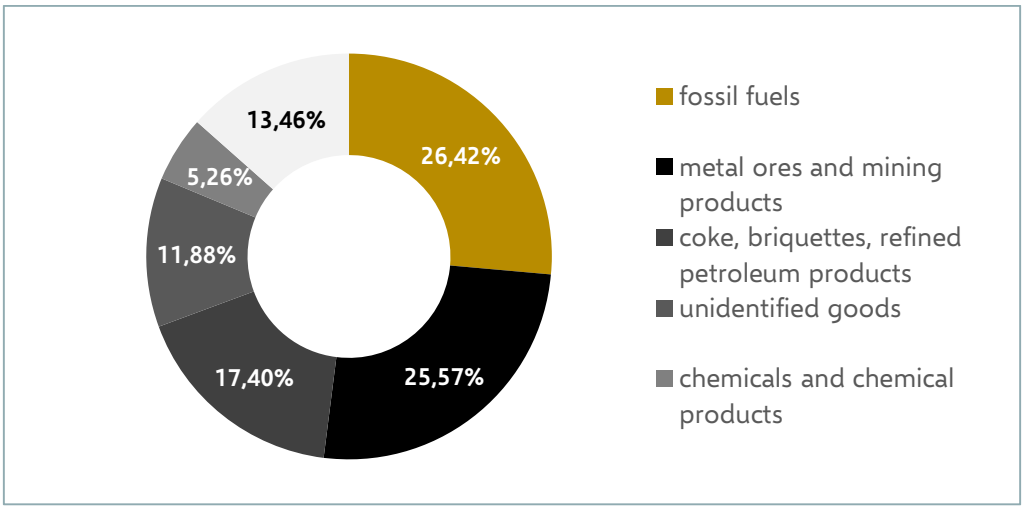


Figure 7: The most popular loads transported by rail

1.3. Slovakia

According to data from 2023, 44 companies have a valid license to provide railway transport services, of which up to 39 companies have a valid license to provide services in freight transport. The state carrier ZSSK CARGO is the only company providing complex transportation of goods from the loading point to the unloading point not only by means of complete trains, but also by transporting groups of wagons or single wagonloads together with the provision of pick-up and delivery by handling trains while ensuring full service throughout the territory of the Slovak Republic. The SWL transport service covers both domestic and international transport (import, export, transit). Currently, private carriers only provide goods transportation services via integrated trains. The market share of individual carriers in the Slovak Republic for the year 2022 in the number of train kilometres is shown in Figure 8.

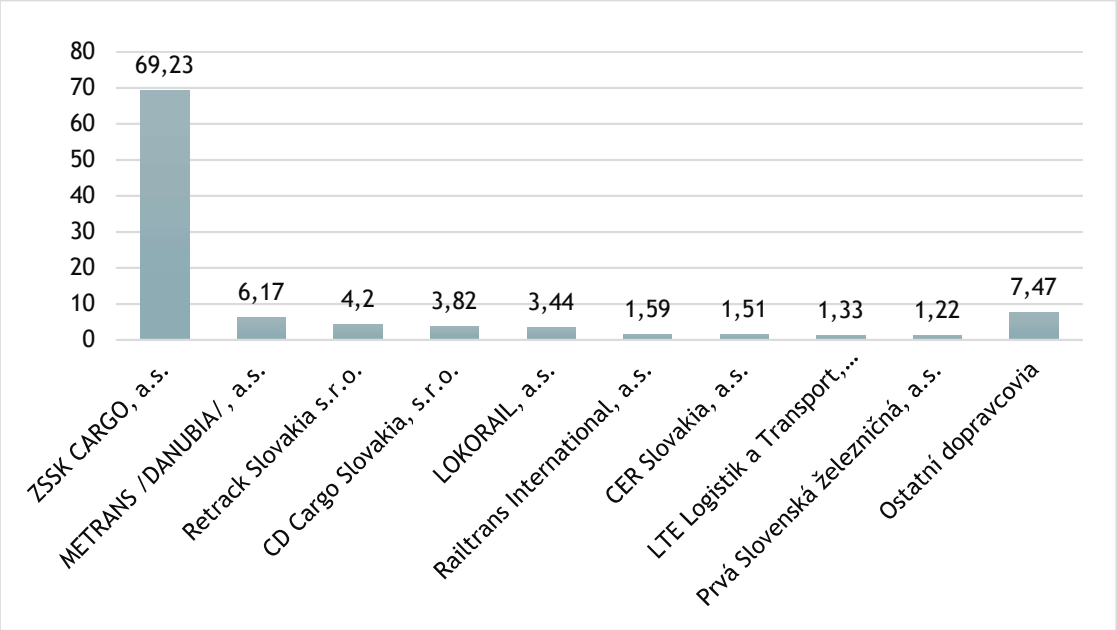


Figure 8: The share of freight carriers in transport performance in 2022
Source: authors, according to AROS

Performance development of carriers operating on the railway transport market of the Slovak Republic has seen stabilized performance since the economic crisis in 2010. The slight increase in performance in freight transport in recent years is related to the motivating effect of Resolution no. 390/2013 – on draft measures for the consolidation of railway freight transport of the Slovak Republic. The development of performance in rail freight transport according to commodities is shown in table 1 in thousands of tons per year for the state carrier ZSSK CARGO.

	2022	2021	2020	2019	2018	2022/2021
Iron ore	10,523	12,351	9,560	10,263	12,121	0.85
Metals	3,489	4,049	3,023	3,349	4,780	0.86
Coal	3,294	3,699	2,915	4,326	5,123	0.89
Building materials	2,812	2,948	2,497	2,980	3,514	0.95
Petroleum products	2,684	2,447	2,382	2,388	2,307	1.10
Wood	1,955	2,052	1,985	2,245	2,434	0.95
Chemistry	1,433	1,959	1,837	1,971	1,889	0.73
Intermodal transport	824	776	1,009	1,044	1,175	1.06
Not specified	845	902	809	794	773	0.94
Grocery store	992	202	205	297	270	4.91
Total	28,851	31,385	26,222	29,958	34,386	0.92

Table 1: Development of freight transport performance by commodity in thousand tons in the period 2018 – 2022
Source: ZSSK CARGO Annual Report, 2022

An overview of the transport performance of the railway freight carrier ZS SKCARGO according to modes is shown in Table 2.

Domestic	2022	2021	2020	2019	2018	2022/2021
Transport goods (thous. Tons)	3,614	3,570	3,258	3,630	3,958	1.01
Transport performance (million net tonne km)	729	674	607	671	722	1.08
Import	2022	2021	2020	2019	2018	2022/2021
Transport goods (thous. Tons)	12,357	13,395	10,427	12,125	14,926	0.92
Transport performance (million net tonne km)	2,065	2,188	1,838	1,962	2,334	0.94
Export	2022	2021	2020	2019	2018	2022/2021
Transport goods (thous. Tons)	7,141	7,941	6,878	7,425	8,683	0.90
Transport performance (million net tonne km)	986	1,103	933	1,066	1,345	0.89
Transit	2022	2021	2020	2019	2018	2022/2021
Transport goods (thous. Tons)	5,739	6,479	5,659	6,778	6,819	0.89
Transport performance (million net tonne km)	2,081	2,306	1,997	2,372	2,329	0.87
Total freight transport	2022	2021	2020	2019	2018	2022/2021
Transport goods (thous. Tons)	28,851	31,385	26,222	29,958	34,386	0.92
Transport performance (million net tonne km)	5,861	6,351	5,375	6,070	6,729	0.92

Table 2: Development of transport performance according to the regime in the period 2018-2022
Source: ZSSK CARGO Annual Report, 2022

In line with other European countries, the volume of single wagonload transport in Slovakia has significantly decreased over the past two decades. Specifically, it has dropped from 23 million tonnes in 2003 to just over 5 million tonnes in 2022. The reason for the decrease in the volume of these transports is not only their technological complexity for processing, but also the fact that it is also the most demanding form of goods transport, which is reflected in its cost and appears to be economically inefficient in certain transports.

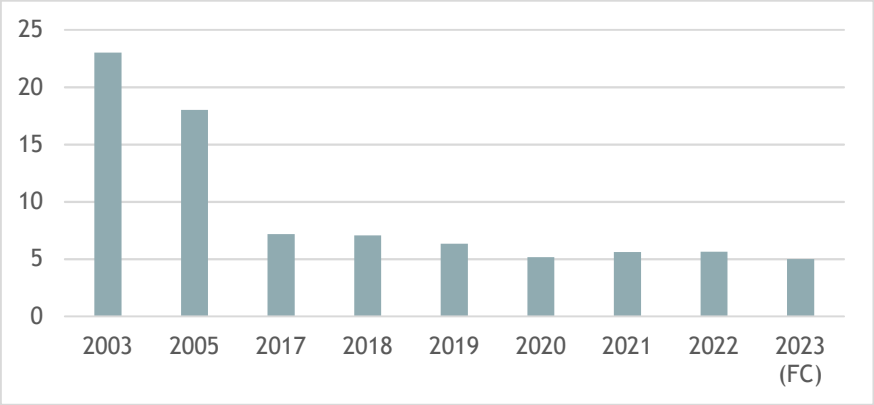


Figure 9: SWL volumes since 2003 in Slovakia
Source: ZSSK CARGO

1.4. Slovenia

The liberalisation of the Slovenian rail freight market started in 2007. As is the case throughout Europe, the new entrants have focused on providing block train services, as these are much more efficient than single wagonload services and much less costly. The SWL service is still provided by the national railway company.

The single wagonload transport is present in the entire territory of Slovenia and offers services for customers who are located outside the area of the main railway lines, major logistics or economic centers. The services for these transports are charged at market prices, i.e. the prices that transport clients are willing to pay.

National company SŽ-Tovorni promet d.o.o. offers single wagonload transport in Slovenia in order to support Slovenian companies and to diverting cargo from road to railways. One of the area, where single wagonload transport is operating, is timber transport. **Project "Single Wood" was launched**, which offers high-quality transport of individual wagon shipments loaded with wood between Slovenia and foreign markets. These transports are mainly intended for users who do not have enough goods to make up a complete train. Individual wagon shipments are collected at various stations in Slovenia and assembled into a complete train at the main shunting station Ljubljana Zalog, which is the main point of contact with daily connections to other destinations in Slovenia and abroad.

In 2023, 1,9 million tonnes of goods were transported by rail in Slovenia under the single wagonload scheme. 41 % of this volume was transported in import traffic, 39 % in export traffic and 20 % in domestic traffic.

The following graph illustrate SWL transport in Slovenia in period 2019 – 2023. SWL transport is decreasing, as shown in the graph below.

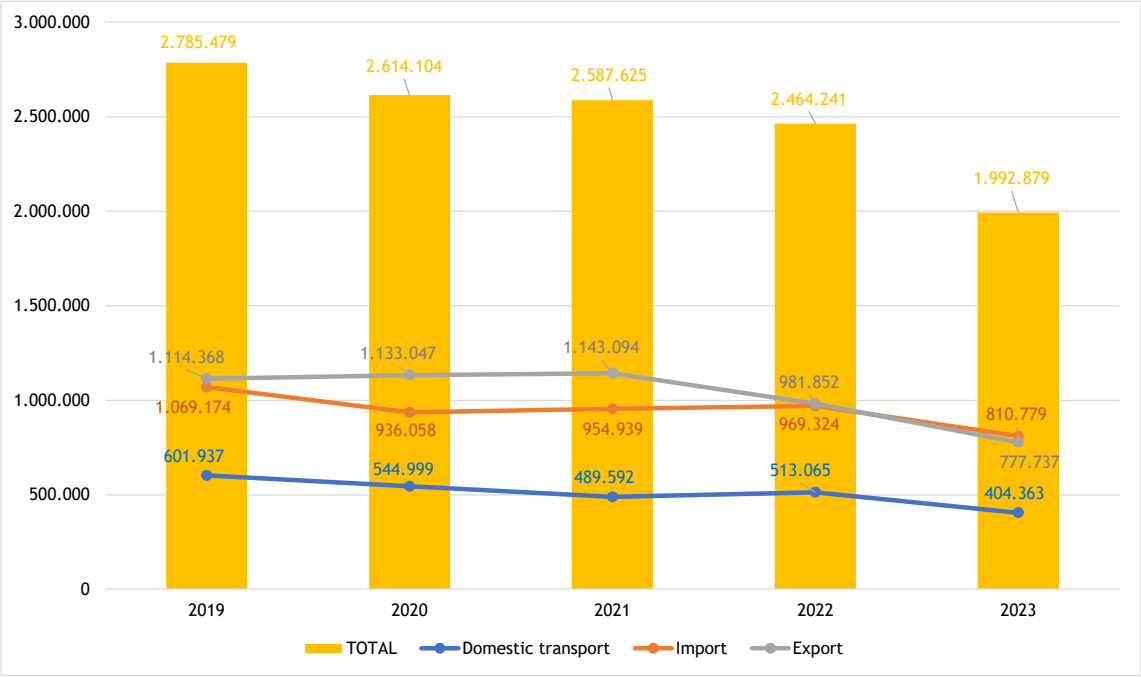


Figure 10: SWL traffic in Slovenia in period 2019 – 2023 (tonnes)
Source: SŽ-Tovorni promet

SWL is an important transport solution, especially in some market segments. However, reasons of the observed decline, both in volumes and in market share, are:

- Low or no profitability of SWL for railway undertakings,
- The direct competition on small shipments with road transport,
- Limited effect on SWL of the liberalization process (new entrants focused on the international and full train markets),

- Reduction of private sidings.

The following graphs illustrate SWL transport in Slovenia in 2023 – import and export breakdown by destination.

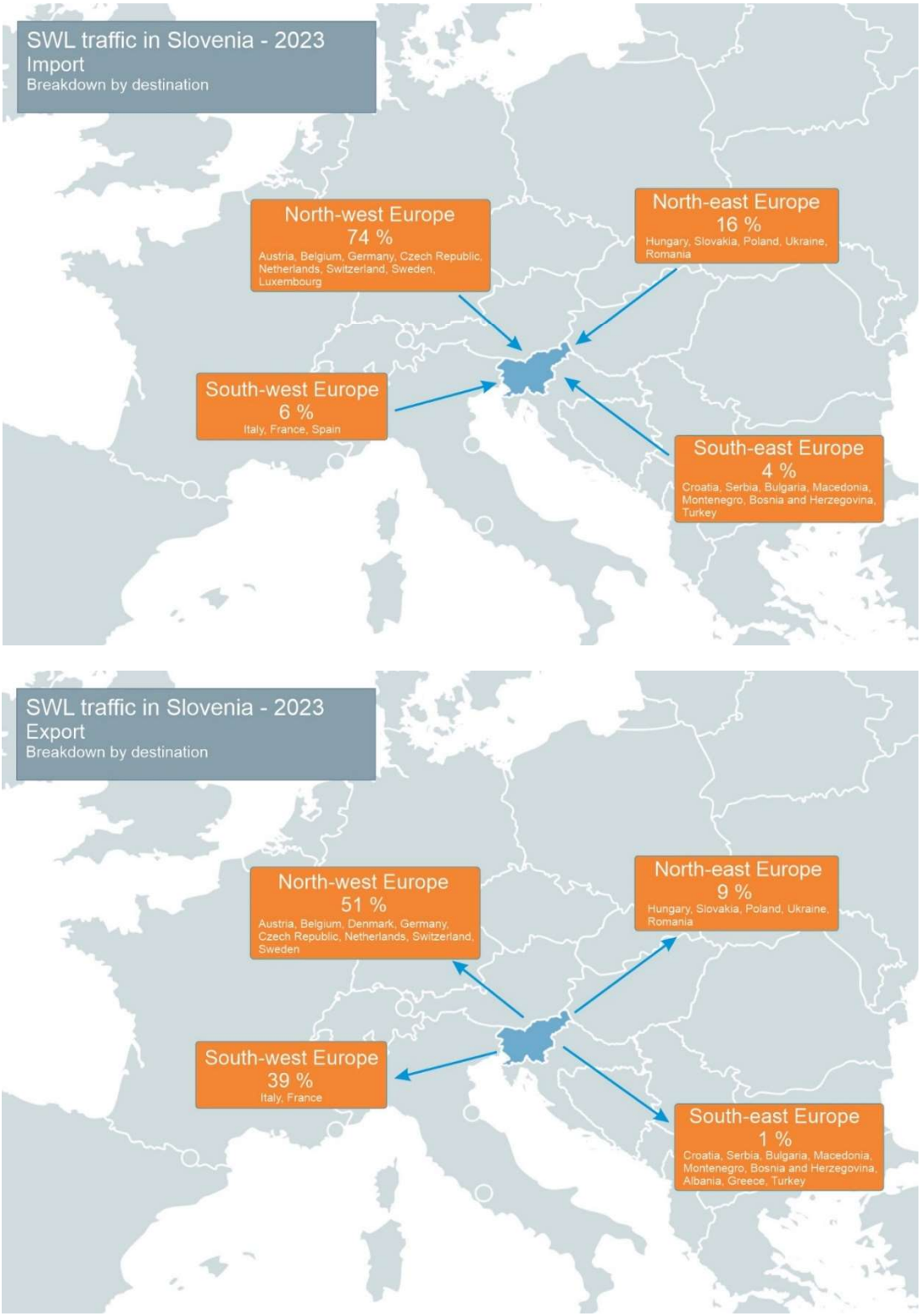


Figure 11: Export and import SWL traffic in Slovenia in 2023
Source: SŽ-Tovorni promet

2. Conditions for keeping the single wagonload transport

- adaptation to market requirements - to increase the quality of service of SWL within the framework of national and international transport.
- compliance with delivery deadlines - nowadays it is an important decision-making factor for the customer when choosing a mode of transport,
- an increase in the frequency of freight trains enabling the inclusion of SWL in the train,
- optimization of transport routes (wagon flows) using optimization methods with the limitation of railway lines from a technical point of view,
- the key factor that affects the amount of these transports is the price.

In the freight rail transport sector, a certain part of the performance is carried out from the forwarding station to the destination station by transporting SWL, which shows a decreasing trend in the recent period. If such transport is to be competitive, in addition to legislation, it is necessary to look for ways to optimize transport and transport processes, which will then be reflected in the prices for the services provided. The organization of wagon streams must consider the requirements of transporters while at the same time optimally using the capacity of the railway infrastructure.

Within the scope of defining the goals of the European Commission declared in the White Book (Transport 2050) for the unified European railway sector, there is also support for the transport of SWL, which currently represent a high-cost and technologically demanding form of goods transport. The goal of the European Union is to transfer at least 50% of freight transport performance to a more ecological mode of transport by 2050, namely on railway lines.

That's why the European Commission started research to strengthen rail freight transport also in the segment of transport of SWL with the following goals:

- Assessment of the importance of the transport of SWL, the aim of which is to quantify the importance of the transport of SWL for the European railway market.
- To identify the main obstacles that caused the decline in the performance of SWL, and to determine the procedure for their elimination and further development of these transports.
- Define short-term or long-term measures to support SWL from the point of view of their development.
- Identification of political support from the point of view of the European Commission for the proposed measures.

There are a number of measures that can help to maintain and increase the volume of single wagonload traffic, to mention just a few of them:

- adaptation to market requirements - to increase the quality of service of SWL within the framework of national and international transport.
- compliance with delivery deadlines - nowadays it is an important decision-making factor for the customer when choosing a mode of transport,
- an increase in the frequency of freight trains enabling the inclusion of SWL in the train,
- optimization of transport routes (wagon flows) using optimization methods with the limitation of railway lines from a technical point of view,

- the key factor that affects the amount of these transports is the price.

An overview of the conditions required to keep SWL traffic is provided in the following chapters.

2.1. Infrastructure

The condition of the rail infrastructure is of crucial importance for rail freight transport and has a significant impact on the single wagonload traffic. The length and density of the railway lines, the number of tracks, the proportion of electrified lines, the technical condition - these are the most important characteristics which alone determine the framework conditions for rail freight transport: the capacity of the tracks, the availability of diesel and electric locomotives, the transport possibilities, the speed, the speed limits due to poor technical conditions of the tracks. All of these factors have a significant impact on both the quality of the service and its cost. The example of Hungary and Slovenia illustrates the rail infrastructure issue.

Hungary

The Hungarian railway network is the 6th most dense in the European Union (85 km/1000 km2) and has a Budapest-centric structure. We can say that the Hungarian railway network lags behind that of the leading EU countries not in terms of its quantity, but in terms of its quality.

A major challenge for Hungarian railways is the very low proportion of double-track and electrified lines. Despite the significant electrification of recent years, only 41% of Hungarian lines are electrified, while on average in Europe there is an overhead line over every second km of track.

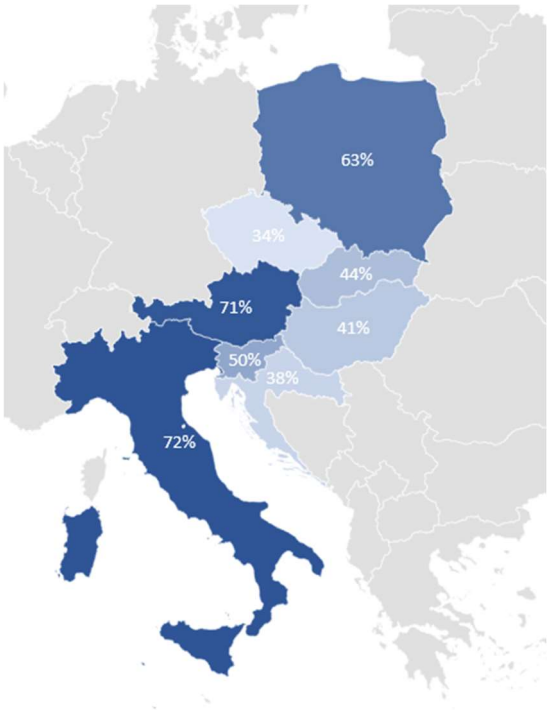


Figure 12: Proportion of electrified tracks
Source: own editing based on Eurostat data

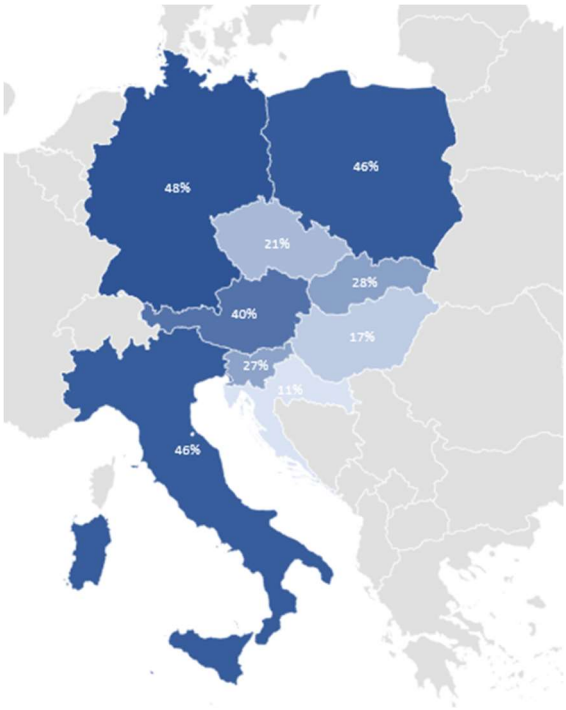


Figure 13: Proportion of lines with two or more tracks
Source: own editing based on Eurostat data

A key factor in the capacity of a railway line is whether it has one, two or more tracks, possibly with tracks used exclusively by freight trains. In this respect, Hungary is at the bottom of the league, only 17% of its railway network is double-track. This is one of the lowest rates in Central Europe.

Almost a third of the Hungarian railway network can carry an axle load of less than 210 kN and on two-fifths of the railway network trains can run at a speed of max.60 km/h. Automatic block signal system is in operation on one third of the network, and app. one third of safety devices at the stations are electronic.

The situation is somewhat more favourable on the TEN-T network, which carries large volumes of rail freight transport: 45% of the lines in the territory of MÁV Zrt. are double-track and 91% are electrified, while 95% of network of GYSEV Zrt. is single-track, fully electrified. Almost 80% of the national core network railway lines are equipped with automatic block signal system, and 90% of them are enable a freight transport at a speed of 100 km/h.

Even on the TEN-T network, the share of sections with an axle load of 225 kN, as required by the TSI, barely reaches 33% (14% on the national railway network). The train load allowed on a given railway line depend mainly on the layout of the line and topography. A modern traction unit can carry a train load of 2 000 tonnes at a gradient of app. 5 to 7‰, but on most of our main lines there are higher gradients of up to 9 to 10‰.

In terms of speed, requirements for freight transport are lower than for passenger transport. The typical permitted track speed on 44% of the TEN-T network is 120 km/h, but slow speed is a significant constraint for freight trains on the Hungarian railway network. The effect of temporary slowdowns, deceleration and acceleration increases journey time and causes additional costs (journey time, traction energy, asset utilisation) which have to be financed by the rail freight undertakings. Another problem is the number and coordination of track closures. Any such restriction poses a serious organisational challenge for carriers: detours imply additional costs and running time, often require diesel traction (change of locomotive), and less favourable train parameters (e.g. lower load capacity) on the detoured route.

The Hungarian railway network is in an urgent need of modernization, but financial resources are only available to a limited extent.

Slovenia

Public railway infrastructure in Slovenia is one of the smallest railway networks in the EU, with only 1,200 km of the lines. Slovenia is located in the central Europe and the railway network spans across the entire country, connecting major cities and towns. The network is also linked to neighboring countries, facilitating international rail transport with four neighbouring states. The transport flows use four rail freight corridors: Mediterranean, Baltic-Adriatic, Amber and Alpine-Western Balkans. Slovenia's railway network plays a crucial role in international transportation, connecting to neighboring countries such as Austria, Italy, Hungary, and Croatia. This facilitates both passenger and freight transport across Europe. While Slovenia doesn't have dedicated high-speed rail lines, it has made efforts to improve rail infrastructure and speed. Upgrades have been made to certain sections of the railway to enhance travel times and overall efficiency.

Lines in Slovenia are divided in two categories main lines and regional lines. Both categories are presented with the share of 50 %. Some of the main railway lines in Slovenia include the main north-south line connecting the capital, Ljubljana, to Maribor in the northeast and Koper on the Adriatic coast. Another significant line connects Ljubljana to the border with Austria. Regional lines are branched from the main lines. 50 % (over 600 km) of the all network is electrified with the direct current electrification with 3 kV. Over 52 % of the railway network, mostly main lines, are acceptable for the axle load 22,5 t/axle. Double track railway lines are available at 27 % of the network.

2.1.1. Shunting infrastructure, humps, marshalling yards

The infrastructure required for shunting and marshalling, its condition and availability are essential for single wagonload traffic.

Recent developments in Hungary, mainly implemented with EU funds to improve passenger transport, have paid little attention to important elements of rail freight transport and to ensuring adequate capacity for freight trains. The modernisation of the major freight hubs and marshalling yards (Budapest-Ferencváros, Celldömölk, Dombóvár, Fényeslitke, Miskolc, Szolnok) has been delayed, and the condition of the track network at the railway station in Budapest-Ferencváros, which is crucial for domestic and international traffic at network level, is critical; despite annual renewals, it can only operate with significant restrictions. The track network of the major rural marshalling yards is currently in a very poor condition, with the exception of Miskolc and Győr. At these two stations there is a significant marshalling operation, at other stations the track conditions have deteriorated in addition to the reduction in traffic: trains can run at low speeds on the tracks and a significant part of track is closed to traffic (e.g. Szolnok, Pécsbánya, Dombóvár, Szeged)

Due to the small Slovenian railway network, only one marshalling yard with hump is in operation in Ljubljana Zalog. Shunting movement with the diesel locomotives is provided on the other main railway hubs (Koper, Celje, Maribor). The shunting locomotive groups of the national railway carrier are also available at some other stations with a lot of freight transport movements (Novo mesto, Nova Gorica) or at the border stations (Sežana, Dobova, Jesenice). The central marshalling yard in Ljubljana consists by the tree main track groups: reception track group, directional track group and outgoing track group. The marshalling yard is crucial for domestic single wagon unit and for the international wagon mixed trains.

2.1.2. Storage tracks

Storage tracks serve as temporary storage areas for railway wagons. This is especially important in freight operations, where the timing of shipments and the availability of specific types of cargo may vary. The storage tracks allow for the temporary holding of freight cars until they are needed for a specific train or shipment.

A sufficient number of wagons is essential to meet the EU's ambitions for strong growth in rail freight. At the same time, the number of passenger wagons is increasing - many more trains and wagons will have to run and be accommodated on the same network than before. The storage requirements of the expanded freight fleet should primarily be met at marshalling yards, maintenance workshops, and major stations along the main freight routes. It is recommended to designate as storage tracks those tracks of stations that are not in use and are in poor condition, after minimal maintenance (to ensure accident-free accessibility).

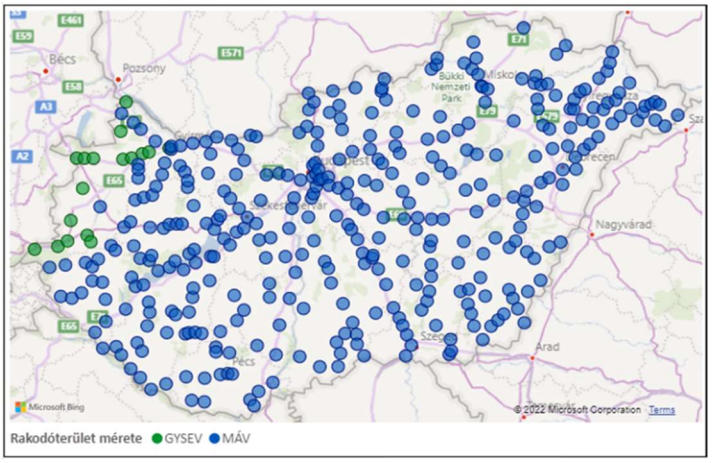
2.1.3. Public loading points

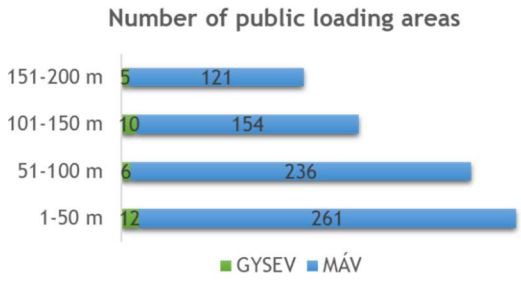
In case of the rail freight transport, some of the consignments are not loaded onto trains at terminals, sidings or dedicated rail networks, but at the so-called public loading points at the railway stations. For single wagonload transport, loading at public loading points is also more important than for consignments transported by block trains.

In order to maintain rail freight transport volume and to shift additional new freight from road to rail, it is necessary to maintain existing capacity of paved loading areas with adequate road connections, loading tracks and to create new loading areas. Single wagonload transport can be made even more efficient by having loading tracks of ideal length and axle load and by using modern loading equipment.

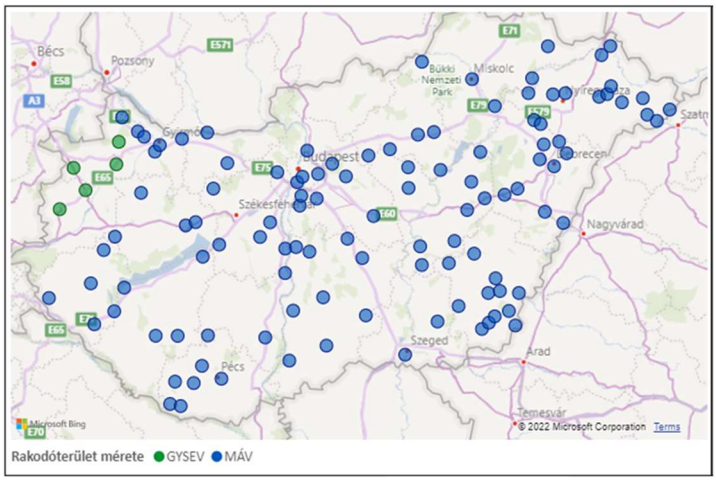
Overall, it can be said that **Hungary** is not considered to be poorly served by railway loading transfer points. It is mainly due to the fact that most stations have not yet been rebuilt and retain their original design from the golden age of the railway. One consequence is that, despite the large number of loading transfer points, they are relatively short: the need to load trains of several hundred metres at the same time appeared first in the second half of the 20th century (There was no traction capacity available to handle longer freight trains before.) Nowadays, this means that freight trains have to be served at the loading transfer points in several stages, which increases shunting work to be done at the stations.

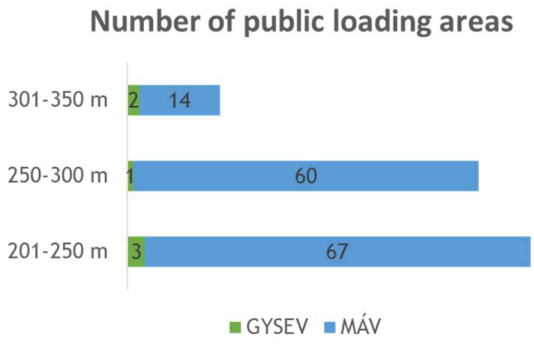
Loading areas up to a length of 200 metres (loading transfer points managed by GYSEV are in green, loading transfer points managed by MÁV are in blue)



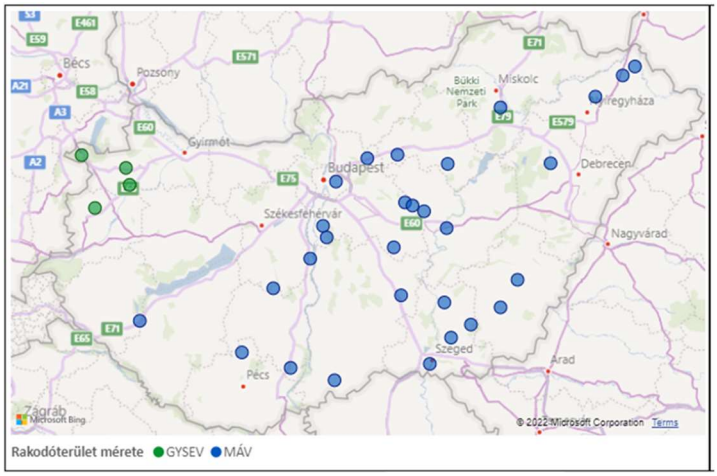


Loading areas between a length of 201 metres and 350 metres:





Loading areas exceeding 350 metres:



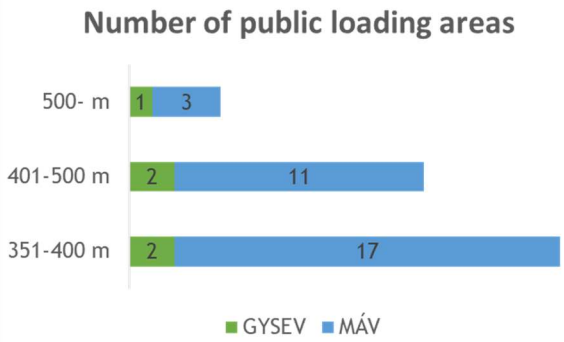


Figure 14: Loading areas in Hungary
Source: MÁV Zrt.

However, in addition to the size of the loading areas, there are now also other problems in Hungary.

Alternative uses: the significant decline in the freight traffic following the change of regime has also led to the emptying of loading transfer points. As loading transfer points are located in accessible areas, operators not interested in rail freight transport have been able to make good use of them. Infrastructure manager, responsible for the asset management has also looked for a possibility of exploiting and letting the assets. Thus, some of the loading transfer points that had been leased (or even sold) for a long period of time were turned into building material shops, scrap collection points or other areas for small-scale industrial activities. Another form of an alternative use is the utilisation of the area for P+R car parks. This will obviously alleviate parking problems in the area and is important for passenger rail transport, but it will limit the scope for freight transport. The least desirable, but nevertheless common use is depositing of 'salvage' material from track construction and maintenance in these areas. In many cases, scrap material consists of timber or steel sleepers, reinforced concrete substructure or other demolition debris from the track maintenance, that are classified as hazardous waste. These often occupy loading transfer points, which can be used for freight transport, for years.

Public complaints, noise and dust: loading transfer points are, by definition, located in the vicinity of railway stations, close to the areas open to passenger traffic. In addition, the development of the municipalities has led to the "building around" the railway, with housing being built in the immediate vicinity of the railway loading transfer points. Although these areas are considered to be industrial areas, and it can be said that the railways were there first, they must nevertheless comply with strict environmental and noise protection standards where there is direct public access. These requirements cannot be met for many common loading technologies, e.g. dusting, damage caused by birds when loading grain, noise pollution when loading containers or bulk building materials, increased HGV traffic due to loading and unloading, etc. In Hungary, for example, following complaints from the public the county governments have adopted a resolution on banning the open loading of grain at several railway stations. For some types of goods and loading technologies, the switch to strict loading technology makes the activity so expensive that it becomes uncompetitive. This will increase the value of loading areas that can be operated away from residential areas with less public disturbance.

Market dysfunctionality: there are app.60 railway companies with network access contracts in Hungary operating in a highly competitive environment, where a difference of up to a few euro cents per tonne in freight charges can determine which company becomes the contracted carrier of the freight owner. Loading

transfer points are often a bottleneck because of the reasons mentioned above. It is particularly the case for grain loading, but we can also find examples in this respect in the area of loading building materials. Railway companies book load transfer point capacities in advance, in line with expected traffic volume, in order to be prepared for a possible transport and thus have a better chance on the negotiations with the carriers. This can result in a particular overbooking of the transport need, because at the time of negotiation, several railway undertakings are booking loading transfer points for the same freight transport operations.

***Good practice**: the solution already applied in Hungary, which allows shippers/cargo owners to book loading transfer points directly, can be used to address the situation: they only need to conclude a framework capacity contract with the relevant infrastructure managers and, as a capacity reservation holder, they can also request capacity directly.*

Overall, we can say that some loading transfer points are enjoying a renaissance in Hungary, have a good utilisation and lively rail freight traffic. Others are more seasonal (because of agricultural products transported) or subject to other conditions (demand for building materials).

Rail Cargo Hungaria has conducted a survey among 35 Hungarian medium- and large-sized companies, which are the main players in the timber transport sector, on their needs in relation to rail freight transport, including the provision of specific wagonload services. Some of the questions related to loading and unloading facilities at the stations. According to the results of the survey, 45% of customers are quite satisfied with the layout of the loading areas and find a suitable station/loading area for the dispatch of their timber products. However, more than 50% of the respondents indicated that the infrastructure of the loading points does not meet the requirements of today's market, with little space for loading.

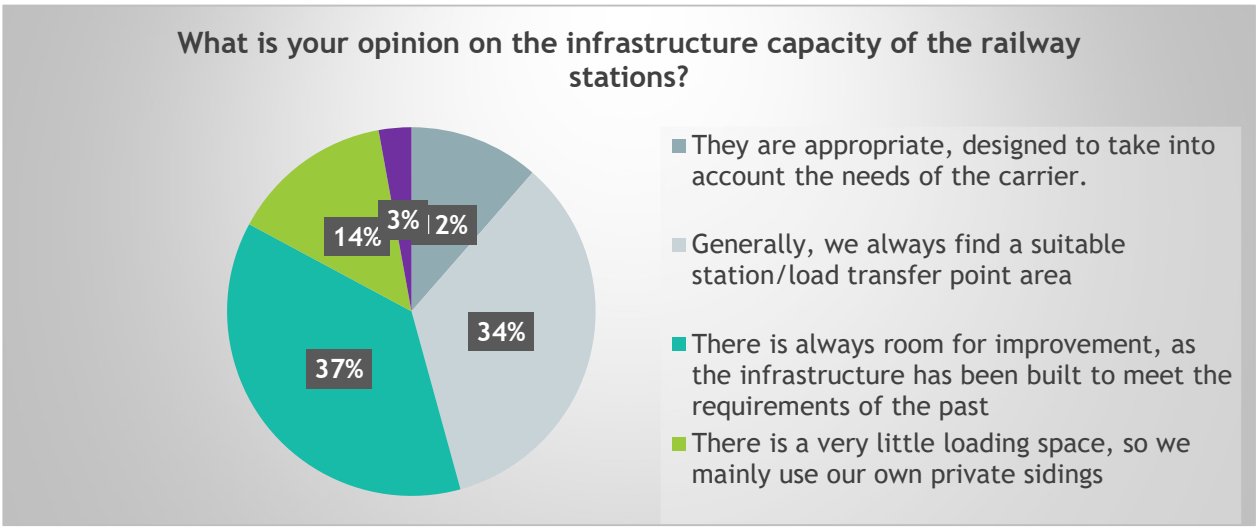


Figure 15: Customer opinions on the infrastructure capacity of railway stations in Hungary
Source: RCH

In respect of a potential increase in traffic, it is important to improve the infrastructure of public loading points, increase the loading area at the loading stations and, at the same time, create areas that can be used for product storage. The latter could make rail freight transport more attractive to customers if the infrastructure were improved.

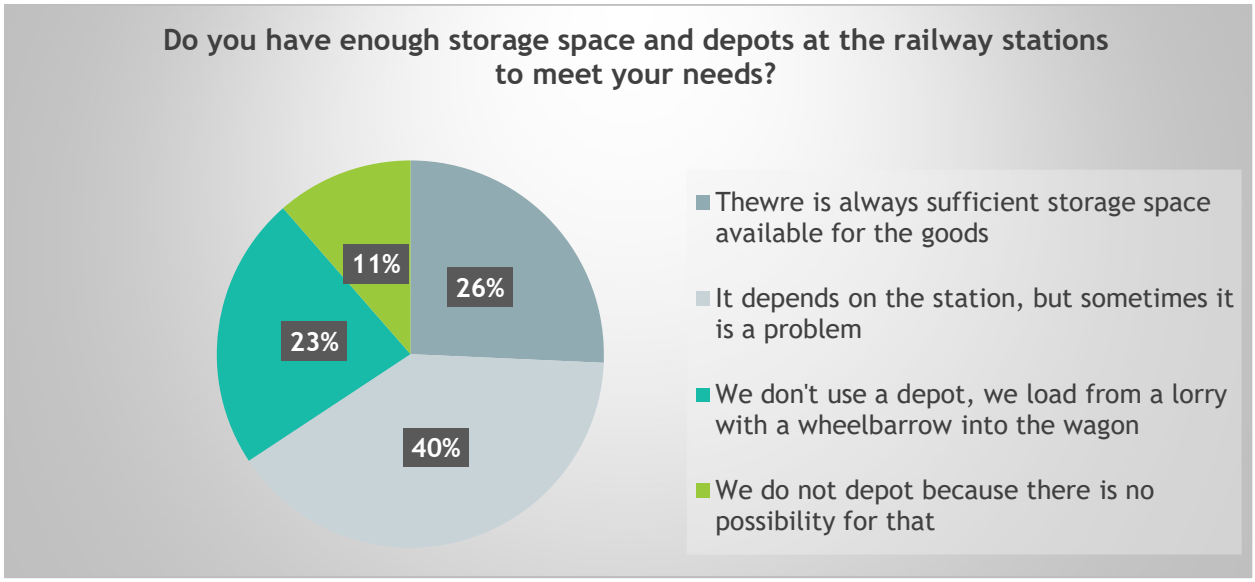


Figure 16: Customer opinions on the storage spece and depots at the railway stations in Hungary
Source: RCH

26% of the respondents were satisfied with the number and availability of depots, but 40% indicated that, depending on the station, there are problems with the quality of the storage space.

Competitiveness of rail freight transport can be increased by improving the number and quality of depots. This is an important consideration for the owner of the goods, as depots are often used for longer periods to ensure continuity of service.

For the needs of loading and unloading goods from and into wagons, ramps located at railway stations are often used. The layout of ramps on the railway infrastructure in **Slovakia** is shown in the figure 17. However, some ramps are currently not in use due to their poor technical condition.

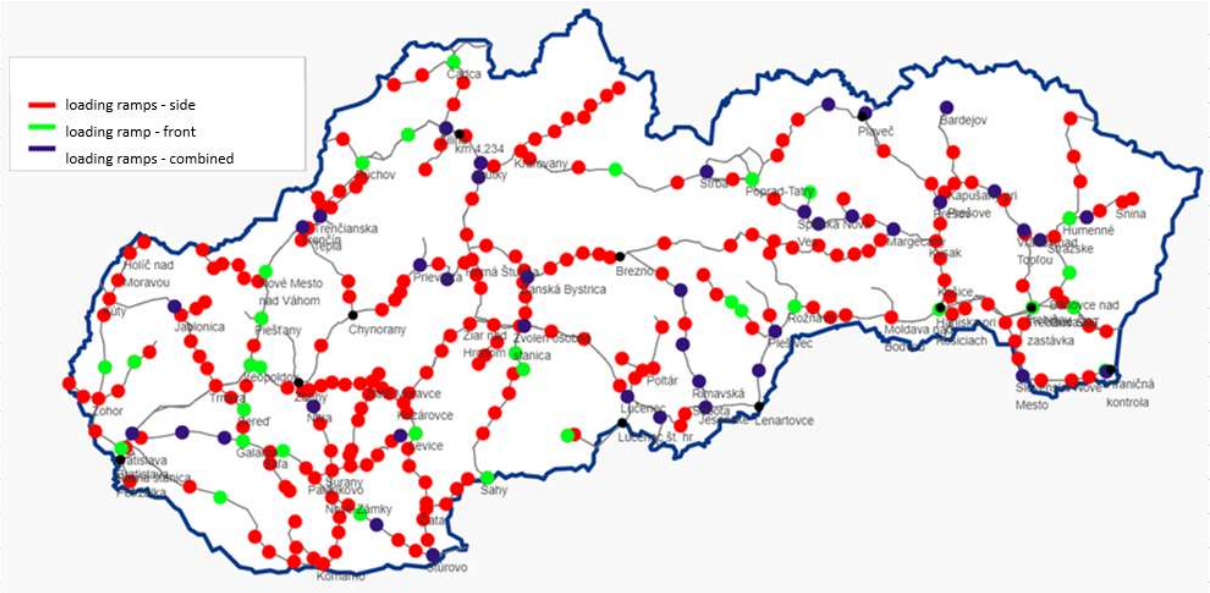


Figure 17: Railway stations equipped with ramps in Slovakia
Source: zsr.sk

In the rail freight transport in Slovenia, most of the consignments are loaded onto trains at terminals, industrial sidings or port of Koper. Public railway infrastructure contains 290 railway service points. 46 % of them are passenger stops, which are not suitable as a loading points for the freight transport. Suitable for the freight loading are only railway stations (presented in 44 %) and loading points (8 %). Loading points are, from the aspect of the traffic management, one level behind the railway station. They cannot cross or overtake the train runs. It only has some side tracks with ramps for the freight manipulations.

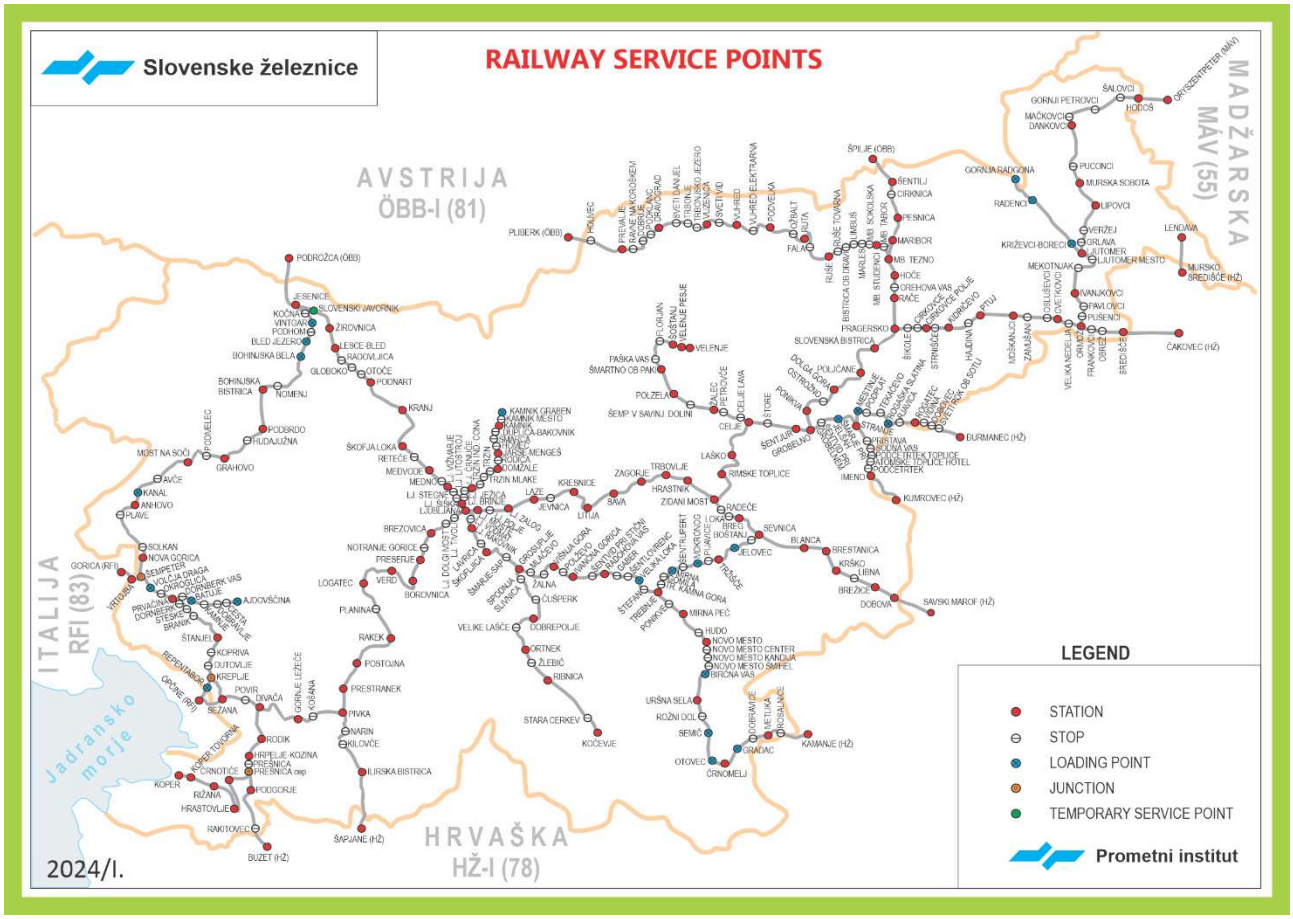


Figure 18: Railway stations equipped with ramps in Slovenia
Source: Prometni Institut Ljubljana

Public loading points in Slovenia are one of the fundaments for the single wagon unit transport. Locomotive operations between loading points provide national freight railway carrier. The wagons are delivered only a few times per week (usually 3). Pick-up trains take the loaded (or unloaded) wagons at the loading point on the defined railway section. Most of the pick-up trains in Slovenia has the start or the end point at the marshalling yard in Ljubljana Zalog.

2.1.4. Industrial sidings

Sidings enable customers to load and unload goods by rail in factories and plants. Door-to-door service is best provided by sidings, because freight wagons can be loaded on the premises. Until the rapid development of road transport in the 1960s and 1970s, many factories had their own sidings, on which the majority of their goods movements took place.

The maintenance of the remaining and operating sidings is expensive: building infrastructure involves high costs, there is a shortage of suitable qualified workforce to maintain the track. In order to get a licence to operate the siding, the owner of the siding must fulfil a number of requirements, that are difficult and costly to meet such as the employment of qualified rail professionals, the provision of infrastructure, the organisation of services, etc. The ageing of qualified rail professionals poses a problem of replacement for all rail freight undertakings, and this is no different for siding operators.

The slow amortisation of the track and the need to adapt to changes in rail freight transport needs (e.g. 225 kN axle load) mean that there are significant development needs for sidings.

In **Hungary** there are currently more than a thousand remaining sidings, many of which have long since ceased to carry freight by rail. The technical characteristics of the sidings in Hungary are illustrated in the diagrams below:

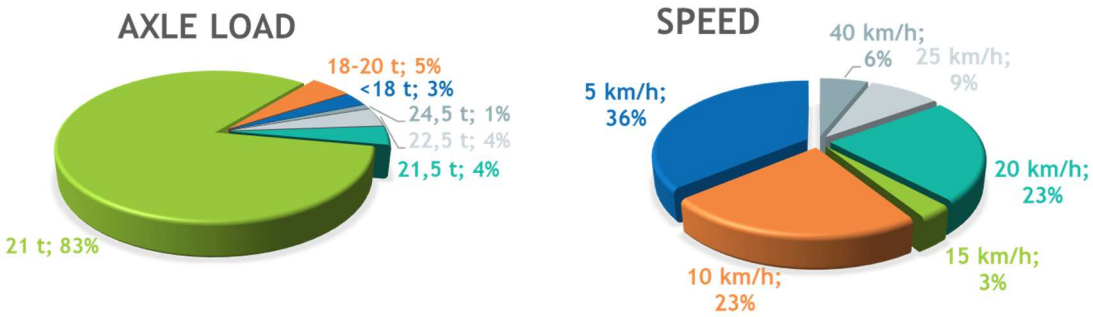


Figure 19: Technical characteristics of the sidings in Hungary
Source: MÁV Zrt.

The installation of new siding and renovation of old, disused siding can be a costly expense for the owner. Therefore, constructing a rail link is a significant investment with a slow return on investment, and it also incurs ongoing maintenance and operational costs. In contrast, a road link is basically " for free " and does not require any investment from companies. This is why public support is needed for the renovation and construction of sidings (e.g. Austria).

Efforts should be made to cover industrial areas and Special Economic Zones (SEZ) with sidings. The introduction of railway sidings to industrial areas, including SEZ's, enables effective integration of railway infrastructure with production sites. One siding serving multiple plants contributes to optimizing the availability of rail transport for various companies in a given area. The lack of sidings in industrial areas requires road transport, generates additional costs and increases environmental pollution.

The existence of sidings creates alternative solutions for cargo transport, reducing full dependence on the quality and operation of road transport. Having a siding enables flexible and direct delivery of raw materials and collection of finished products, shortening the supply chain. This increases logistic flexibility, especially for companies that work in a "just in time" model or require fast, punctual deliveries.

The introduction of railway sidings into the area of the integrated distribution centers of retail chains enables a direct connection between the place where goods are stored and the railway infrastructure. This, in turn, reduces transportation time and costs, supporting the fast and efficient flow of goods. Placing a siding directly within the warehouse center allows direct access to rail transport for goods that are both intended for the local market and those that are to be transported further away.In the context of food shipments, sidings enable the optimization of transport routes. Direct access to the warehouse center allows for quick and controlled transfer of food loads, which is crucial for maintaining the quality of products. Integrating sidings with distribution centers supports sustainability goals by minimizing road transport. As a

greener means of transport, rail can help reduce emissions and pollution associated with the transport of goods.

On the Slovenian public railway network is connected about 208 industrial sidings. Most of them is connected to the nearest public railway stations. Some of the sidings are directly connected to the open line sections. 75 % of them is active, but the frequency of the rail deliveries is very different. Some sidings get the deliveries every day, other every week or month, some with the low frequencies only few times per year. It also exists active sidings, without deliveries in the last few years. The other 25 % of sidings are closed or abandoned with removed tracks.

The maintenance of the operating sidings is expensive for the industry, beside the infrastructure, the industrial sidings demands additional shunting locomotives or similar devices for the movement of the wagons inside the factory.

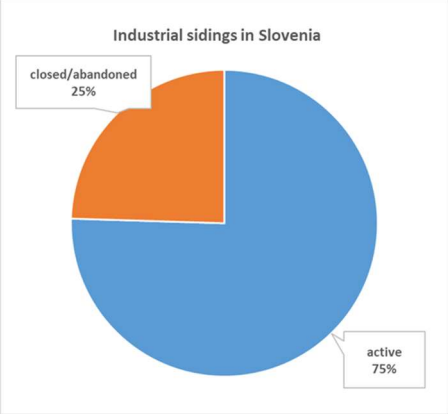


Figure 20: Industrial sidings in Slovenia
Source: SŽ-Infrastruktura

The Port of Koper has the longest industrial sidings network in Slovenia, with more than 40 kilometres of tracks. The port cannot be directly compared with industry and factories, as it does not produce anything, but only transfers cargo from ships to wagons and vice versa.

2.2. Technical-technological issues

2.2.1. Mainline and shunting locomotives

Both diesel and electric, mainline and shunting locomotives are required to handle single wagonload traffic. Most of the branch lines are not electrified and diesel locomotives are also needed to serve the sidings. The locomotive fleet of the railway companies providing single wagonload traffic in the countries under analysis generally consists of older locomotives, as described in more detail below.

In Slovakia the ZSSK CARGO uses various locomotives, in many cases also diesel locomotives, for moving and organizing the SWL. The company operates outdated locomotives with high fuel consumption. The average age of the motor traction locomotives in the 742 and 751 series is 39 and 52 years, respectively. The outdated locomotives are unreliable, require high operating and repair costs, and are a significant financial burden for the company.

The structure of the rolling stock of the ZSSK CARGO is shown in Table 3.

	Total	Up to 15 years	Up to 30 years	Over 30 years
Electric locomotives	216	x	8	208
Diesel locomotives	208	48	29	131
Motor vehicles	1	x	x	1
Total	425	48	37	340

Table 3: Structure of rolling stock of the ZSSK CARGO
Source: ZS CARGO Annual Report, 2022

Figure 21: Locomotive fleet of ZSSK CARGO
Source: Maros Mozucha, RD Leopoldov, 19-11-2023; FB Železnice na Slovensku; ZS CARGO Annual Report, 2022)

Rail Cargo Hungaria is in a slightly better position in Hungary. It has no locomotives of its own; its fleet consists of leased locomotives, but these are relatively new, modern electric locomotives that are capable of recuperation, and some diesel locomotives for traction and shunting. However, this fleet is not sufficient to meet all of its traction and shunting needs, so it also purchases traction services from other railway companies, mainly from the state-owned MÁV-START, which provides passenger transport services. MÁV-START's locomotives, like those of other Central European state railways, are quite old. The 630 series, which is mainly used for electric traction, is 34-48 years old and will reach the end of its service life in the next decade. It is important for MÁV-START Zrt to purchase new locomotives, but it is likely that they will only be used for passenger transport.

***Good practice**: Rail Cargo Hungaria has signed a contract to lease electric-hybrid traction and shunting locomotives, which are pioneering in Europe.*

The Multi-System electric locomotives will be the first freight-optimized E-Locomotives in Europe. It can be operated as a shunting locomotive in non-electrified networks such as stations, ports and freight yards with the "Super Last Mile".

The green lithium battery power package can avoid fuel waste and air pollution.

Figure 22: multi-system electric locomotive BISON
Source: RCH

Figure 23: multi-system electric locomotive BISON
Source: RCH

The CHA1B1 hybrid shunting locomotive is designed for the operation in Hungary. It combines the usage of catenary and lithium battery power. The traction power at wheel in catenary mode is 850 kW, while in battery mode it amounts to 400 kW. By using the lithium battery, the vehicle can be used on tracks without catenary. Furthermore, when in battery mode, the shunter emits zero emissions and runs with reduced noise and vibration, enabling environmentally friendly operation.

The following table shows the locomotives in Poland:

Traction vehicles	2018	2019	2020	2021	2022
locomotives	3 563	3 655	3 401	3 188	2 942
electric	1 449	1 487	1 386	1 376	1 255
combustion	2 101	2 146	1 981	1 741	1 609
two-drive	13	22	34	71	78

Table 4: Traction rolling stock available in Poland

A considerable amount of single wagonload traffic originates from and/or arrives at sidings. The movement, marshalling, and pulling of wagons alongside a loading ramp or warehouse on sidings cannot be accomplished by shunting locomotives alone. Road-rail vehicles may also be employed for this purpose.

Technological solutions in the field of traction vehicles

Hybrid technology (bimodal/two-traction) in locomotives is a solution that combines combustion and electric drives, increasing energy efficiency. Two-traction locomotives have a traditional internal combustion engine, usually powered by diesel or gas, which serves as the main source of propulsion. This engine can operate independently or in combination with an electric drive.

Hybrid technology allows the locomotive to operate on both electrified and non-electrified sections. Thanks to this, hybrid locomotives are more versatile, able to serve different routes without the need to change rolling stock.

The implementation of advanced systems for monitoring the consumption of drive means in locomotives opens the way to more effective and sustainable energy management. Advanced monitoring systems enable precise recording of energy consumption in real time. This allows you to determine exactly how much energy is used during different phases of the journey. By collecting data on energy consumption in various conditions, it is possible to precisely analyze the energy efficiency of the locomotive.

Monitoring systems allow for the analysis of energy efficiency depending on the route and speed. You can optimize your route plan and adjust your speed to the terrain conditions, minimizing energy consumption. These systems can recognize patterns of energy behavior, taking into account differences in energy consumption during take-off, braking and driving on hills. By monitoring torque and load, the systems can optimize engine operation in real time. This leads to more efficient use of energy under various operating conditions.

Effective management of energy consumption translates into reduced operating costs. Locomotives can be operated more economically, which benefits both the railway company and the environment.

2.2.2. Wagons

The wagon fleet owned by rail freight undertakings in Hungary consists of app. 14,000 wagons, including vehicles registered in other countries. The members of the Hungarian Association of Private Railway Freight Wagons (MVMSz), which brings together the owners of private freight wagons in Hungary, have a total of 7,000 wagons, of which about 2,000 are registered in Hungary.

The Hungarian freight wagon fleet was basically built before the change of regime. This means that the Hungarian freight wagon fleet corresponds to the technical standard and traffic requirements of the period before the change of regime, with an average age of app. 35 years. Over half of the freight wagons are open wagons, and an increasing number of wagons (container wagons and pocket wagons) are used for intermodal traffic. The Hungarian freight wagons are outdated not only because of their average age, but also to the fact that they would now have to carry an axle load of 225 kN in order to be able to carry out transport operations economically on the Western European route.

The results of rapid innovation in rail freight transport, climate-friendly and more energy-efficient traction vehicles, quieter, specialised and multifunctional wagons are slowly gaining ground in Hungary. The Hungarian wagon fleet has still few, albeit growing, new designs of vehicles that can be used for intermodal transport, including containers and semi-trailers. There are also few multifunctional wagons with variable load space, variable load capacity and simple loading, which meet the requirements of the single wagonload and palletised goods transport.

In Slovakia, ZSSK CARGO, the single wagonload operator, has a fleet of much younger wagons, with most of them being between 6 and 15 years old, as shown in the table below.

	Total	0-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26-30 years	Over 30 years
E - open (high-walled) wagon of ordinary construction	163	x	x	156	x	x	x	7
F - open wagon of special construction	200	x	x	200	x	x	x	X
G - covered wagon of ordinary construction	3	x	x	x	x	x	x	3
H - a covered wagon of special construction	154	x	x	150	x	3	x	1
K - flat wagon of ordinary construction	4	x	x	x	x	x	x	4
L - flat wagon of special construction	202	x	175	27	x	x	x	x
R - flat chassis wagon of ordinary construction	310	x	x	x	296	x	x	14
S - flat chassis wagon of special construction	775	x	29	521	x	147	78	X
T - wagon with an openable roof	4	x	x	x	x	x	x	4
Z - tank wagon	1	x	x	x	x	x	x	1
U - wagon of special construction	16	x	x	x	x	x	x	16
Total	1,832	x	204	1,054	296	150	78	50

Table 5: Age structure of the fleet of freight wagons of the carrier ZSSK CARGO
Source: Annual report of ZSSK CARGO, 2022

The wagon fleet of ZSSK CARGO has slightly increased by 200 wagons in the last 5 years. This increase is mainly due to an increase in the number of open wagons.

	2022	2021	2020	2019	2018
Covered wagons	161	161	164	172	171
Open wagons	363	363	364	164	166
Flat wagons	1,291	1,292	1,294	1,294	1,295
Other freight wagons	17	17	1	1	1
Total Freight wagons	1,832	1,833	1,823	1,631	1,633

Table 6: The structure of the freight wagon fleet of the ZSSK CARGO carrier
Source: ZSSK CARGO Annual Report, 2022

Contrary to the trend in Slovakia, the size of the available wagon fleet in Poland has decreased over the last 5 years, while its composition has also changed to meet the needs of the market. The detailed data are shown in the table below.

	2018	2019	2020	2021	2022
coal trucks of normal construction	46 990	46 757	45 892	42 730	41 136
specially constructed coal trucks	14 687	14 720	13 881	13 558	13 483
indoors of normal construction	171	148	78	52	49
indoor special construction	1 904	1 917	1 264	1 259	1 259
normal construction platforms on axles	555	602	578	553	553
special construction platforms on axles	100	20	20	0	0
normal construction platforms on trolleys	5 362	5 768	4 413	4 388	4 043
special construction platforms on trolleys	6 956	7 063	8 228	9 856	9 896
with an opening roof	1 596	1 555	1 555	1 569	1 575
special	5 343	4 299	4 272	4 465	4 493
tanks	50	49	48	48	48
Total	85 732	84 917	82 249	80 499	78 557

Table 7: Trailer rolling stock at the disposal of railway undertakings in Poland

Covered wagons are gradually losing their importance. Their main use was to carry general cargo, mail and other goods requiring protection against weather conditions. Global containerization and the growing use of intermodal cargo units for transporting general cargo have significantly reduced the demand for traditional covered wagons. Although special-built covered wagons are still used, especially thanks to the possibility of direct loading and unloading of pallets on loading ramps using sliding walls, normal-built covered wagons are regularly taken out of service.
Between 2012 and 2022, more than 2,700 covered wagons of normal construction were decommissioned in Poland. At the end of 2022, only 49 wagons of this type were available for freight carriers.

Platform wagons are an important element of the railway fleet, adapted to transport various loads, such as concentrated loads, logs, vehicles or piece cargo. Depending on the design and number of axles, there are different types of platform wagons:
Platform wagons of normal construction, based on axles and bogies, equipped with sideboards and stanchions to secure loads. Selected models have pins for mounting containers.
Specially constructed platform wagons are additionally equipped with special elements enabling the transport of containers, replaceable containers, vehicles or sheet metal coils. They may have sliding side walls, similar to specially constructed covered wagons, as well as tarpaulins to protect the load. Among the platform wagons of special construction, it is worth distinguishing double-decker models designed to carry motor vehicles.

Although platform wagons have traditionally been used in freight transport, the containerization of transport has contributed to strengthening their role in rail transport. The increase in investments in intermodal transport resulted in a significant increase in the number of platform wagons available to railway carriers in Poland at the end of 2022, almost doubling from 2012 figures.

The innovative railway wagon with a low rotatable loading platform for transportation of truck vehicles by rail developed by a team from the Military University of Technology in Warsaw, represents a breakthrough in the field of intermodal transport. This unique vehicle is covered by patent protection at the national and European level. Its test implementation is planned in the coming years.

Figure 24: Innovativ railway wagon with a low ratable loading platform

The essence of such reloading is to place the semitrailer on a special rotatable platform with the use of a truck tractor. The structure can be used for transportation of different types of vehicles such as tractors, trucks, trailers, semitrailers and cargo containers. The wagon allows quick and fast loading and unloading without any platform infrastructure or terminals. The process of loading and unloading the trailers can be performed considering a whole train or individual wagons from any part of the train (no cranes needed). This type of railway wagon will allow transport companies to save time and money for road transport. The advantages of this construction are reduction of the negative impact on the environment as well as an increase of road safety by reducing the number of vehicles on the roads.

Several modular lightweight concepts have been developed on the European market, as shown in the following figure.

Figure 25: Modular concepts in Europe
Source: RCH

A common feature of modular systems is that they provide standardised flat wagons with a structure that meets the needs of different customers. The chassis is generally lighter than in case of the conventional freight wagons, so the net weight/payload can be higher, reducing unit transport costs. Modular superstructures are also available in a variety of designs tailored to the specific industry sector. The interchangeability of the superstructure enables in this way to adapt to the changing logistical requirements.

***Good practice**: TransANT, jointly developed by RCG and Voestalpine, can be used without restriction in conventional single wagonload transport. The intelligent connection point between body and superstructure of the freight wagon enables the vehicle to run on humps in gravity yards.*

The WoodTainer/MonTainer system consists of high performance special containers optimised for bulk transport, lightweight InnoWaggons and the corresponding unloading solution. Suitable and robust containers are available for all types of bulk cargo, including wood chips, waste paper, biomass, coal, coke, ores, cement, gypsum and contaminated soil. As an integrated logistics solution, the WoodTainer/MonTainer system has been developed so that the containers, together with InnoWaggons, allow optimised loading for minimum train lengths. Depending on the customer's needs, different unloading solutions are available: forklift or unloading systems at the railway station. Both systems guarantee efficient logistics and maximum operational safety under all conditions.

Figure 26: InnoWaggon 80 feet + WoodTainer XXL wagon with a payload capacity of up to 62 tonnes
Source: RCH

The wagon fleet owned by national rail freight undertaking in Slovenia (SŽ-Tovorni promet) consists of app. 1.700 wagons.

The rolling stock of SŽ-Tovorni promet consists of wagons of different types, suitable for transporting all types of cargo in accordance with the expectations of customers. If necessary, their number is supplemented by hiring additional wagons.

Wagon type	No.	Ref. series of wagon	As on Dec. 31, 2021	As on June 30, 2022	Year of purchase	Life span	Avg. utilis. (2021 in %)
			No. of maintain. wagons	No. of maintain. wagons			
E	1	Eas	441	441	1971-1973	18	84.9
	2	Eaos	100	100	1971-1973	18	88
	3	Eamos	9	9	1992	18	97.5
F	4	Faccs	67	67	*1973-1980*	18	95.1
	5	Fals	116	119	*1972-1982*	18	95.9
H	6	Habis	35	35	*1973*	20	28.2
	8	Habbi[ll]ns	99	99	*2006*	20	44.4
	9	Hbbill	3	3	*1999*	20	69.6
	10	Hbis	10	10	*1982-1989*	20	28.3
	11	Hi[ll]mrs	19	19	*1999*	20	35.6
K	12	Kgs	17	17	*1981-1982*	18	61.8
R	13	R[e]gs	111	110	*1972-1986*	18	91.5
S	14	Sgs[s]	148	148	*1973-1980*	20	92
	15	Sggrrs	100	100	*2016-2018*	30	99.1
T	16	Tad[d]s	356	370	*1973-1989*	20	78.3
U	17	Uacs	40	40	*1973-1991*	18	82
Z	18	Za[e]s	11	11	*1971-1983*	20	72.3
Total			**1,682**	**1,698**			

Table 8: Freight wagons owned by national freight undertaking
Source: SŽ-Tovorni promet

2.2.3. DAC

Today, many manual operations are needed to get a freight train ready to go: manual coupling and uncoupling, time-consuming manual operations during train preparation (brake test, technical wagon inspection). For each wagon traffic, this is multiplied by the number of times a wagon has to be shunted from one train to another.

The digital automatic coupling (DAC) is a technology that allows the automatic connection and disconnection of the rolling stock in a freight train, both physically and digitally. The DAC has many opportunities for improving the efficiency, safety, and sustainability of the European rail freight sector. Some of the opportunities are:

Increasing capacity: The DAC enables the formation of longer trains up to 750m, which can transport more goods with fewer locomotives and drivers. The DAC also reduces the time needed for coupling and decoupling operations, which can increase the availability and utilization of the rolling stock.

Increasing productivity: The DAC allows the automation of other operational procedures during train preparation and train run, such as automated wagon registration, automation of the technical wagon inspection, automatic brake test, train integrity function, and distributed power/loco control. These features can reduce the human intervention and error and improve the reliability and performance of the freight trains.

Increasing quality: The DAC provides a secure data communication throughout the train, which enables the use of telematic applications for improved customer information and maintenance. The DAC also supports the electro-pneumatic brake, which generates lower longitudinal compressive forces and reduces the wear and tear of the rolling stock. The DAC can also contribute to the modal shift to rail, which can reduce the greenhouse gas emissions and noise pollution from road transport.

2.3. Traffic management

In order to maintain single wagonload transport, we have to perform very costly sub-tasks: providing shunting locomotives, shunting crews, technical, commercial and operational staff, operate marshalling yards where wagons carrying consignments are sorted by direction. The core of rail operations technology is that freight wagons carrying single wagonload consignments dispatched from low-traffic stations are collected by a hub freight train and delivered to the nearest hub, where they are grouped into domestic fast freight trains and then forwarded to the next hub, usually by another hub freight train to the destination.

Although the cost of the technology is high, the service is essential to the national economy.

For the single wagonload system to work smoothly, it must be predictable. Hub freight trains and domestic fast freight trains, forwarding single wagonload consignments must run according to a well-planned timetable. In this way, customers can easily schedule when wagons will be delivered for loading, when they will be forwarded, and even calculate arrival times based on the timetable of the forwarding trains, provided that there are no unexpected events or delays. For international traffic, a fixed timetable is also crucial, because partner railways in neighbouring countries, taking over trains carrying single wagonload consignments at the border, have to order their own timetables accordingly.

The current model of the assembly of freight trains (train formation) on the Slovak Railways network is not based on any concept. Since 1995, it has been carried out based on long-established procedures.

Train engineering deals with the very technology of carriage of wagon shipments, its management and organization of the movement of wagon streams from the sender (place of dispatch) to the receiver (place of destination).

Shipments are transported by different types of freight trains, considering the transport distance and the agreed technology, namely (Internal materials of ŽSR):

- Handling train (Mn),
- Express freight train (Nex),
- Express freight train of combined transport (NexKD),

- Special continuous freight train (OsPn),
- Special freight locomotive train (OsRvND),
- Special siding train (OsVlec),
- Continuous freight train (Pn),
- Continuous freight train of combined transport (PnKD),
- Locomotive freight transport train (RvND),
- Locomotive test freight transport train (RvSkND),
- Siding train (Vlec).

As part of the transport of goods from the forwarding station to the destination station, it is possible to carry out transport by various types of freight trains. Figures 27 and 28 characterize the distribution of freight trains, their average daily number and average weight.

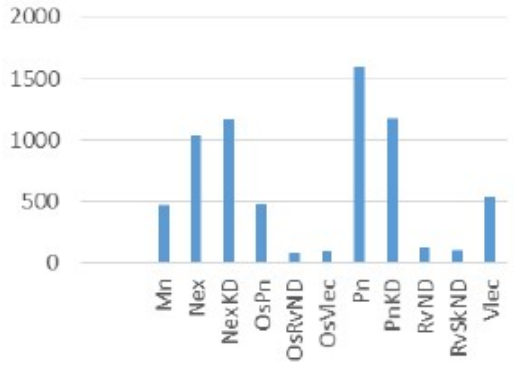


Figure 27: Average weight of freight trains in Slovakia [t] in 2022
Source: ŽSR

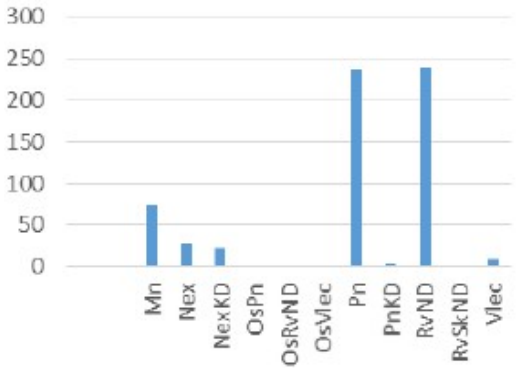


Figure 28: Average daily number of freight trains in Slovakia in 2022
Source: ŽSR

Within the Slovak Republic, goods are mostly transported by continuous freight train (Pn), which has an average capacity of 1600 tons, or by combined transport freight train (PnND), whose average daily capacity is 1200 tons. Approximately 470 tons are transported daily by the handling train (Mn).

Improving the technology of the organization of the single wagon transportation helps to achieve the fulfilment of customer requirements and create a positive economic result. We can approach the overall streamlining of technology at two levels:

- innovation of the technical base (vehicles, security and technical equipment in stations and on the track),

- the innovation of the organization and management of train movement together with the wagon flows on the transport network, which means the adjustment of technological procedures in the processing of freight trains in train formation stations.

The result of the entire process of organization and management of wagon flows is the train formation plan of freight transport, which determines the division of wagon flows into specific sessions and subsequently assigned to specific freight trains. The freight transport of train formation plan is drawn up based on basic documents and train formation stations on the ŽSR network.

The train flow represents the number of wagons or wagon units between two train formation railway stations in a certain time unit. It is characterized by several features:

- has its beginning (handling place, dispatch station or border station) and end (handling place, destination station or border station),
- by routing path,
- is formed by the number of wagons or wagon units,
- characterized by the shipment (weight, harmonized nomenclature of goods, loaded, empty, wagon shipment, complete train),
- direction index.

Wagon flows of laid and empty wagons within the railway network are one of the most important sources from which the model for solving the train formation problem is based. For the actual calculation of the model of the solution to the train formation problem, forecasted wagon flows are used, obtained from load and transport flows, expressed in net tons per year and differentiated based on the volume share of the realized types of transport. The very implementation of the routing and relocation of train streams lies in the variability of their transportation from the forwarding station to the destination station. We can carry out the organization of carriage streams in two ways:

- if the train stream is switched in all route train formation stations, then we are talking about a section variant of the train formation plan (Figure 29).

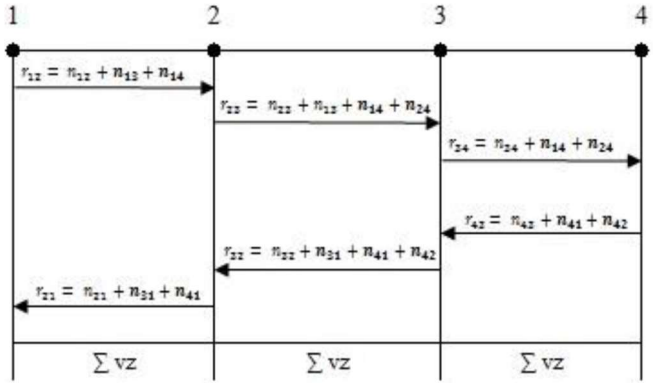


Figure 29: Sectional variant of train formation
Source: Čamaj, 2009

- if the train stream is transported directly from the forwarding station to the destination station by a direct train, then we are talking about a long-distance (full) variant of the train formation plan (Figure 30). In this case, there is a direct session between the stations.

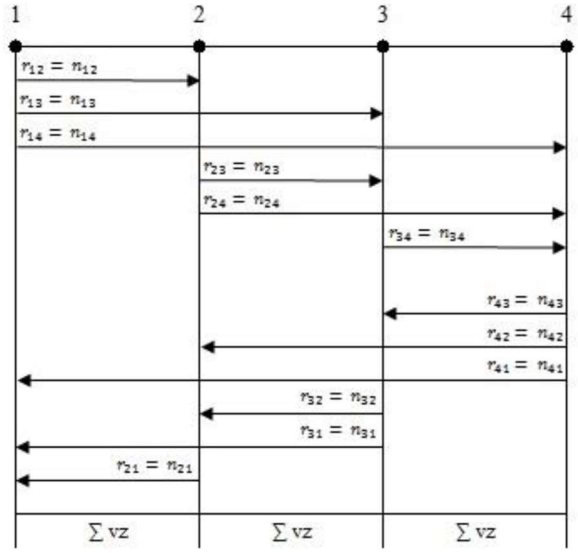


Figure 30: Complete variant of train construction
Source: Čamaj, 2009

When solving the routing of SWL between train formation units, many combinations of their joining arise, which are affected by the number of stations, their geographical location as well as the branching of the track sections connecting the stations. The advantages and disadvantages of combining wagon streams are shown in table 9.

Advantages	Disadvantages
reducing the consumption of wagon hours for the collection of wagon streams in the originating train station	increased demands on train staff, which is also reflected in increased costs
increase in the number of attendants in intermediate stations	reduction of section speed on the track section between the marshalling yards
increasing the number of freight trains serving	

Table 9: Advantages and disadvantages of combining wagon streams
Source: authors

2.3.1. SWL transportation system

The SWL transportation system in Slovakia includes the transportation of individual wagons or groups of wagons (a group represents 5 or more wagons on 1 consignment note) according to the train formation plan.

The existing technology of the SWL system is used in the Slovak Republic as follows:

- the shipment is submitted for transport at forwarding station authorized for SWL,
- the shipment is moved using a handling freight train to the first staging station, from where the wagon shipment, after the destination train set has been separated and the departure train set has been collected, is usually moved by a sequence of continuous freight trains through wayside staging stations with transfer to the last marshalling yard, while in all wayside marshalling yard and also in the last marshalling yard, reordering and collection of consignments is carried out,

- the shipment is transported to the destination station using the Mn train.

This whole system works thanks to the establishment stations, of which there are a total of 7 in Slovakia, as shown in Figure 31, while Čierna nad Tisou has two establishment stations (Bratislava East, Košice, Štúrovo, Zvolen nákl. stanica, Žilina – Teplička, Čierna nad Tisou – two stations).

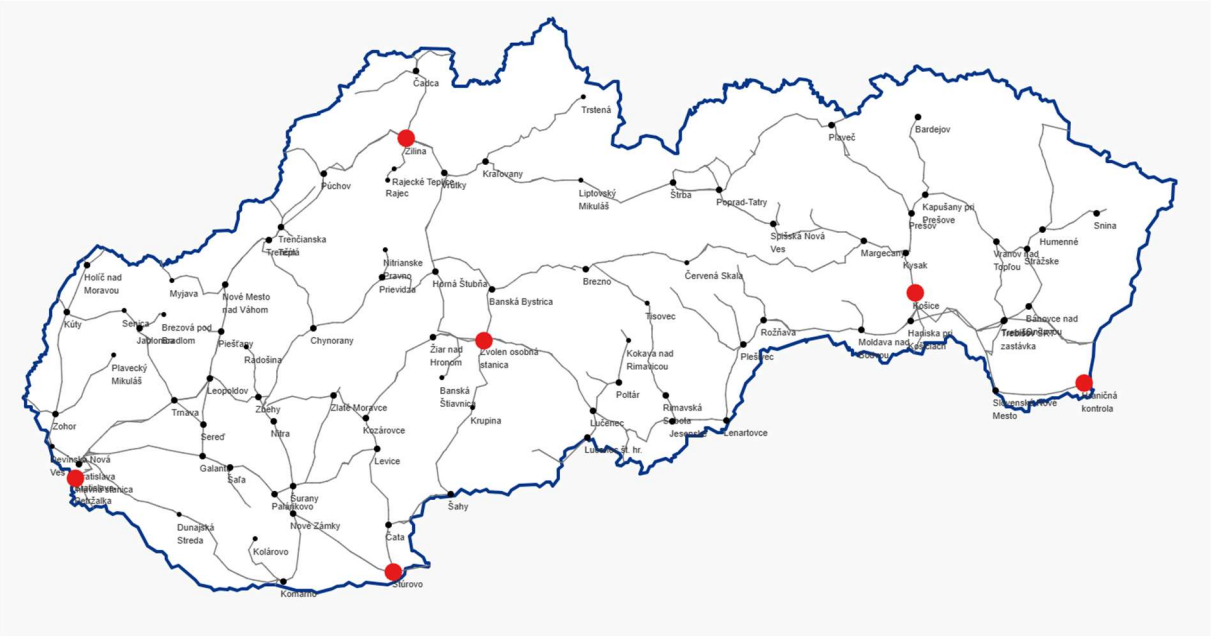


Figure 31: Marshalling yards in Slovak Republic
Source: authors, according to ZSSK CARGO

The routing path for each pair of stations is regulated by the ŽSR service tool Routing data for wagon loads, which contains provisions for the routing of freight wagons. The transport of wagon loads is governed by regulation ŽSR SR 70 - Numbering of stations, stops, depots and other transport railway network of the Slovak Republic and according to its Annex 1 and regulation D16.

Goods can be transported on the railway network of the Slovak Republic:

- from/to all stations with dispatch authorization on the ŽSR network,
- from/to all tariff crossing points,
- from/to all transport locations and points.

Routing of wagon shipments is carried out according to the Freight Transport Train Formation Plan, which is analysed and adjusted every year according to the requirements of the commercial department. It consists of the following separate parts:

- General provisions - the introduction of the freight transport train formation plan, which describes the types of freight trains, their parameters and numbering, the characteristics of regional and integrated trains and their content, defines the train formation station,
- Special provisions - the part that regulates the conditions of running trains,
- Relational load switching from routing stations (part A) - consists of the so-called load table, which is also called oblique. It contains a description of the load movement between individual train formation stations,
- Instructions for delivery and collection of loads (part B) - describes instructions for shifting, resp. load shedding in stations served by the Mn train,

- Overview of routes and freight transport train scheduling (part C) - determines technical and technological data on freight trains on the ŽSR network,
- List of attachments.

Routing of sessions between individual train formation stations is carried out according to part A - switching of the relational load from routing stations (load table). The determination of the routing path is carried out according to the numbers of train formation stations, which are three digits (101-165) and border points, which is four digits and determines the direction to neighbouring countries.

The transport of one or more loaded freight wagons, which takes place from the forwarding/departure station to the destination/arrival station with the need for manipulation (change of train composition) on the transport route in the territory of Slovakia, is the transport of SWL.

The condition for including a shipment in the SWL group is:

- transport carried out on publicly available railway infrastructure in Slovakia (part of the first and last mile can be carried out on a private track - siding, purpose-built track, freight yard, terminal, etc.),
- transportation carried out in the mode of import, export or domestic transport,
- transport carried out in the loaded direction,
- the shipment must be transported by at least 2 trains, while the composition of the individual trains must not be the same.

Consignments transported in freight wagons are considered SWL:

- handling and siding trains, which are used to pick up/deliver loads from/to intermediate stations,
- in regular trains between the marshalling yards Bratislava East, Košice, Štúrovo, Zvolen nákl. stanica, Žilina – Teplička, Čierna nad Tisou – two stations
- in trains in which wagons from several forwarding stations are assigned to one destination station (collective trains),
- in trains in which wagons from several forwarding stations are included in one exit border border station (collective trains),
- in trains in which wagons from one input border station are assigned to several destination stations (collective trains).

Handling decisive for the inclusion of the shipment in the SWL group is not considered:

- change of locomotive specifications carried out on a transport route in the territory of Slovakia when changing traction, connecting or disconnecting locomotive specifications due to the technical parameters of the track (push, sleeper, etc.),
- splitting a train into several sets without changing the composition of the train or combining a group of wagons into one train without changing its composition (due to insufficient performance of the locomotive requirements and for other reasons on the part of the carrier, technical parameters of the track, etc.),
- disconnection of the wagon from the train due to decommissioning (insufficient technical condition of the wagon detected during transportation),
- manipulation (train formation) carried out at the Čierna nad Tisou railway station due to transshipment, unless there is a change in the composition of the train/subsequent trains on the transport route in the territory of Slovakia,

- manipulation, which is carried out abroad, if the composition of the train/subsequent trains does not change during transport on the territory of Slovakia.

At the same time, transportation is not considered SWL:

- empty wagons,
- wagons with empty containers,
- wagons in transit mode (the forwarding/departure station and the destination/arrival station are outside the territory of Slovakia) except for shipments that will be processed at the marshalling yards Bratislava East, Košice, Štúrovo, Zvolen nákl. stanica, Žilina – Teplička, Čierna nad Tisou – two stations (these shipments are considered SWL),
- wagons loaded with the commodity iron ore (NHM 2601),
- wagons in trains from one forwarding station from one sender to one destination station for one recipient, even if it is transported by several trains on part of the transport route,
- wagons in trains from one forwarding station from one consignor to one outgoing border station, even if it is transported by several trains on part of the transport route,
- wagons in trains from one entry border station to one destination station, even if it is transported by several trains on part of the transport route.

In the Slovak Republic, the majority carrier in rail freight transport is ZSSK CARGO, whose share in the transport performance in net tonne kilometres was up to 73% in 2022, which represented 1,042.3 billion net tonne kilometres. ZSSK CARGO's share of the transport performance in train kilometres was 65% for the given period (Internal ZSSK CARGO materials). The reason for the lower share of the transport performance in train kilometres is the transport of SWL. ZSSK CARGO's share of SWL transports in 2021 was 95%. A comparison of transport performance in net tonne kilometres in the SWL segment for the years 2020 and 2021 (ZSSK CARGO) in individual transport modes is shown in Figure 32. In the transit mode, only the transport performance of shipments considered as SWL was considered.

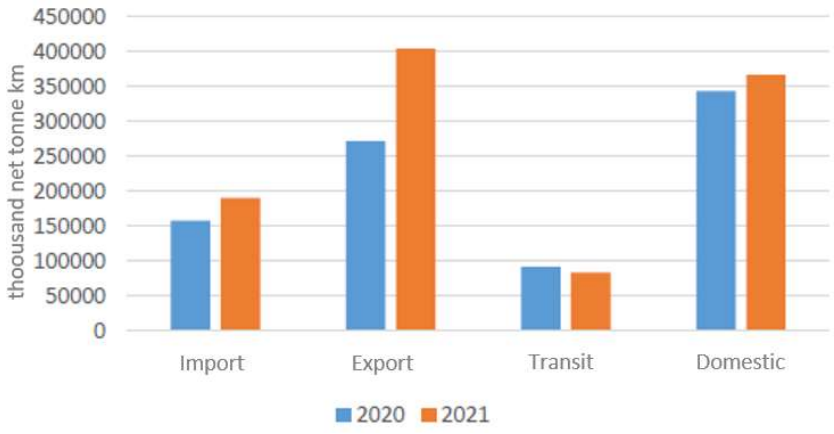


Figure 32: SWL transport performance in individual modes of transport in Slovakia
Source: ZSSK CARGO

Of the modes of transport, domestic transport with a share of 39.8% in 2020 was the most significant contributor to the transport of SWL, in 2021 exports with a share of 38.7%. The average transport distance for SWL transports increased by 2.21% to 209.4 km in 2021 compared to 2020. The highest average transport distance (outside the transit mode) was in the domestic transport mode in 2021, namely 200.4 km, in 2021 in export mode – 220.3 km. In 2021, the average wagon load for SWL transports increased by 3.9% compared

to 2020 (in 2020 the average wagon load was 41.1 t), while the highest wagon load was in the export mode in both years (in 2020 - 43.7 tons and in 2021 – 44.8 tons).

The costs of SWL transport are different not only with respect to the mode of transport, but also with respect to the transported commodity. Figure 33 shows the transportation of SWL by commodities.

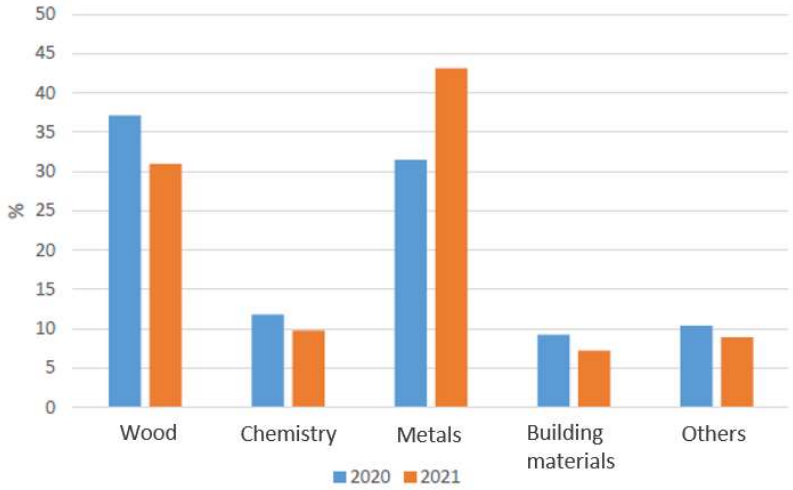


Figure 33: Commodity structure of SWL transport in Slovakia
Source: ZSSK CARGO internal materials

Note: The increase in output for the metal commodity is due to a change in the technology of exporting metal production from a steel mill in eastern Slovakia with the processing of shipments on the way in the marshalling yard Košice or Žilina – Teplička (shipments transported to various customers abroad)

In 2020, the commodity wood and in 2021 the commodity metals took the most significant part in the transport of SWL. The share of commodity transport in individual modes of transport is slightly different compared to total transport. In domestic transport, the commodity wood (49.2% in 2020 and 41.7% in 2021) and the commodity metal (22.8% in 2020 and 34.8% in 2021) took the largest part in the transport of SWL. In the import mode, the metal commodity contributed the most to SWL transports (43.4% in 2020 and 40.9% in 2021), in the export mode the wood commodity (46.9% in 2020 and 41.7% in 2021) and commodity metals (34.7% in 2020 and 52.5% in 2021). In the transit mode, the commodity chemistry (46.6% in 2020 and 41.5% in 2021) and the commodity metals (34.0% in 2020 and 38.9% in 2021) had the largest representation.

The average distance of single wagon loads by mode are as follows:

- National transportation: 203.24 km
- Import from neighbouring countries: 130.75 km
- Export: 79.00 km
- Transit: 313.09 km

Most of the single wagon loads were to/from Hungary, the average distance of single wagon loads by mode are as follows:

- Imports from Hungary: 117.83 km
- Export to Hungary: 144.43 km
- Transit from Hungary through Slovakia: 247.65 km
- Transit through Slovakia to Hungary: 258.51 km

In Hungary, Rail Cargo Hungaria is the only railway undertaking offering nationwide single wagonload services. Transport system of SWL is based on international and domestic freight trains, that can be classified as follows:

- International freight train: a train forwarding single wagon load consignments from a marshalling point to a foreign destination or from a foreign destination to a marshalling point.
- Domestic fast freight train: a train forwarding single wagonload consignments between marshalling points
- Domestic freight train: a train carrying single wagonload consignments, connecting a marshalling point with a service point
- Service train of a railway centre: a freight train providing services for a service point
- Siding servicing train

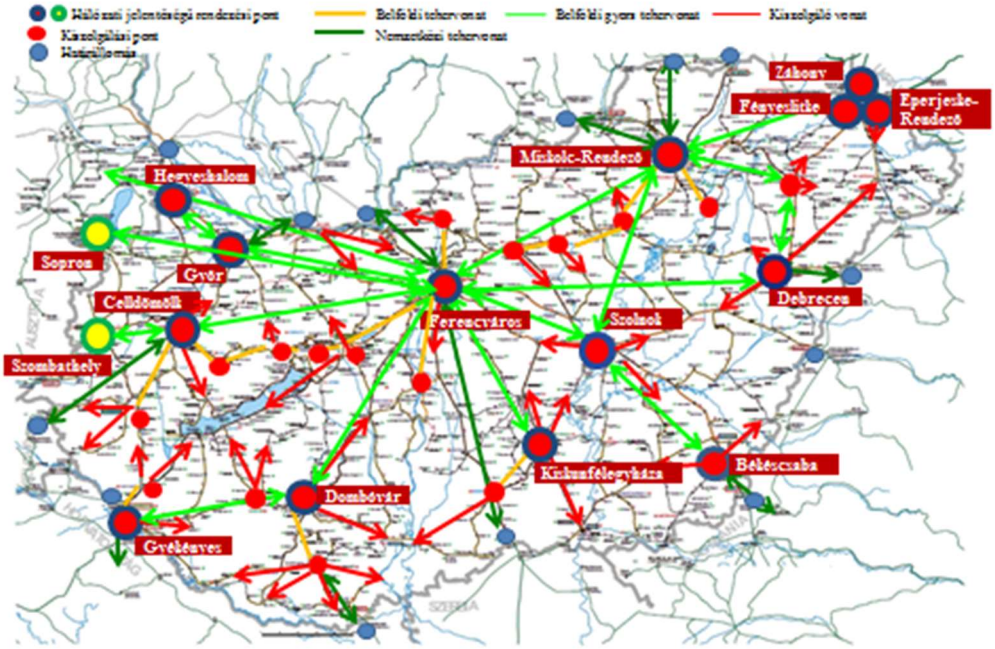


Figure 34: SWL transportation system of RCH
Source: RCH

A marshalling point is a railway station, where new trains are composed from trains arriving from several directions. It provides services for the railway stations situated in its area. A service point is a service station, from which freight trains depart only to a marshalling point. It serves the railway stations in its area. Each railway station is assigned to a service point. This is where consignments are going to be dispatched and transferred, carried out either by a scheduled train of a railway centre or a siding servicing train. Composition and forwarding of freight trains is governed by the Order of Dispatching and Forwarding (ETR). ETR applies only to trains, forwarding single wagonload consignments, to marshalling points and service points. RCH schedules the traffic for a timetable period and sends it to the Infrastructure Manager, who takes it into account when preparing the operating plan and technology for a railway station concerned.

The technological processes of a station (re-sorting times of trains) are recorded in the table on consignment connections.

Routing and locations of re-sorting of single wagonload consignments are recorded in the routing matrix. The table specifies the routing of freight wagons (from and to a marshalling point) and the number of sortings between two marshalling points.

honnan	Győr	Sopron-Rendező	Celldömölk	Szombathely
Szolnok	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros-Celldömölk
Békéscsaba	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros-Celldömölk
Debrecen	Miskolc-Rendező-Budapest-Ferencváros	Miskolc-Rendező-Budapest-Ferencváros	Miskolc-Rendező-Budapest-Ferencváros	Miskolc-Rendező-Budapest-Ferencváros-Celldömölk
Fényeslitke	Miskolc-Rendező-Budapest-Ferencváros	D	Miskolc-Rendező-Budapest-Ferencváros	Miskolc-Rendező-Budapest-Ferencváros-Celldömölk
Nyíregyháza	Miskolc-Rendező-Budapest-Ferencváros	D	Miskolc-Rendező-Budapest-Ferencváros	Miskolc-Rendező-Budapest-Ferencváros-Celldömölk
Hatvan	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros-Celldömölk
Vámosgyörk	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros-Celldömölk
Füzesabony	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros	Hatvan-Budapest-Ferencváros-Celldömölk
Miskolc-Rendező	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros	Budapest-Ferencváros-Celldömölk
Budapest-Ferencváros	D	D	D	Celldömölk
Hegyeshalom határ	D	Győr	Győr	Győr-Celldömölk

Figure 35: Part of the routing matrix of RCH
Source: RCH

2.3.2. Path allocation and cancellation conditions

Allowing railway companies access to the railway infrastructure is one of the prerequisites for achieving a competitive market for railway services.

The manager of the railway infrastructure, in accordance with the principles of non-discrimination, has full responsibility for the allocation of routes, for permission to enter the transport route by individual railway transport companies (carriers) providing transport on the track. The allocation of the route can have a long-term nature in terms of time, the allocation of the route(s) is taken into account and incorporated in the compilation of the year-round timetable and also in the case of planned changes, or a one-off nature, route allocation (also called "ad hoc") takes place during the validity of the timetable and responds to inequalities in the creation of supply and demand for transport services on the rail transport market, usually in freight transport. The stability and quality of the schedule can be threatened by the absence of free capacity, which has been exhausted after the allocation and completion of the construction of the annual train traffic diagram.

In the complex process of capacity allocation, it is necessary to know the real value of the capacity of the railway infrastructure, its qualitative indicator while respecting the qualitative parameters of transport operation. This is a prerequisite for the infrastructure manager to offer routes for authorized applicants for access to the transport route and, after fulfilling the appropriate conditions, the carrier then proceeds to directly assign the route to the year-round timetable, or after completing the construction of the train traffic diagram, to create a catalogue of free routes.

Infrastructure capacity is allocated by the infrastructure manager based on framework rules. In the framework rules, it shall determine in particular:

- method of allocating infrastructure capacity,
- basic details of the application for allocation,
- time periods for which the capacity is allocated,
- rules for concluding framework agreements,
- rules for assessing the purpose of using railway infrastructure,
- sample contract governing the rights and obligations of the infrastructure manager and applicants,
- method and deadlines for informing about the content of the framework rules. (Act 513/2009).

The capacity of the railway infrastructure is allocated according to the principles of ordering train paths into the year-round train traffic diagram. The requirements must be applied in accordance with the Schedule for the composition of the train traffic diagram, which is issued by the General Directorate of ŽSR annually with national regulations (Network Statement, 2012). Priority is given to regular train paths. International train paths must be harmonized and agreed upon as necessary by all participating neighbouring infrastructure managers and train path clients. Domestic train paths, as needed, are not ordered to train traffic diagram. Railway companies will notify ŽSR of their transport plans and train parameters. According to the notifications received, ŽSR will compile a network of tender paths that will be available to all railway companies. The offer will be compiled in such a way that it copies the received announcements and creates a prerequisite for an optimal and economical train traffic diagram set-up and subsequent operation on the ŽSR network (Network Statement, 2012).

Infrastructure capacity once allocated cannot be transferred by its recipient to another person; this does not apply if the recipient, who is not a railway undertaking, enables the railway undertaking to use the allocated infrastructure capacity during its business activity. Such enabling the use of infrastructure capacity is not considered to be its transfer for purposes of further allocation. (Law 513/2009).

Infrastructure capacity in the form of a train path can be allocated to the applicant for the longest period of validity of one timetable of the railway network. The infrastructure manager can conclude a framework agreement with the applicant on the use of the infrastructure capacity for a longer period than the validity period of one timetable. The specific rights and obligations of the infrastructure manager and the applicant regarding the allocated infrastructure capacity shall be regulated in the infrastructure capacity allocation contract. If the applicant intends to ask the infrastructure manager for the allocation of infrastructure capacity with the intention of carrying out international passenger transport, the basic purpose of which is to transport passengers between stations located both in the Slovak Republic and in another member state, he shall notify the infrastructure managers and the regulatory authorities of these states (Act 513/2009). The division of train paths is shown in Figure 36.

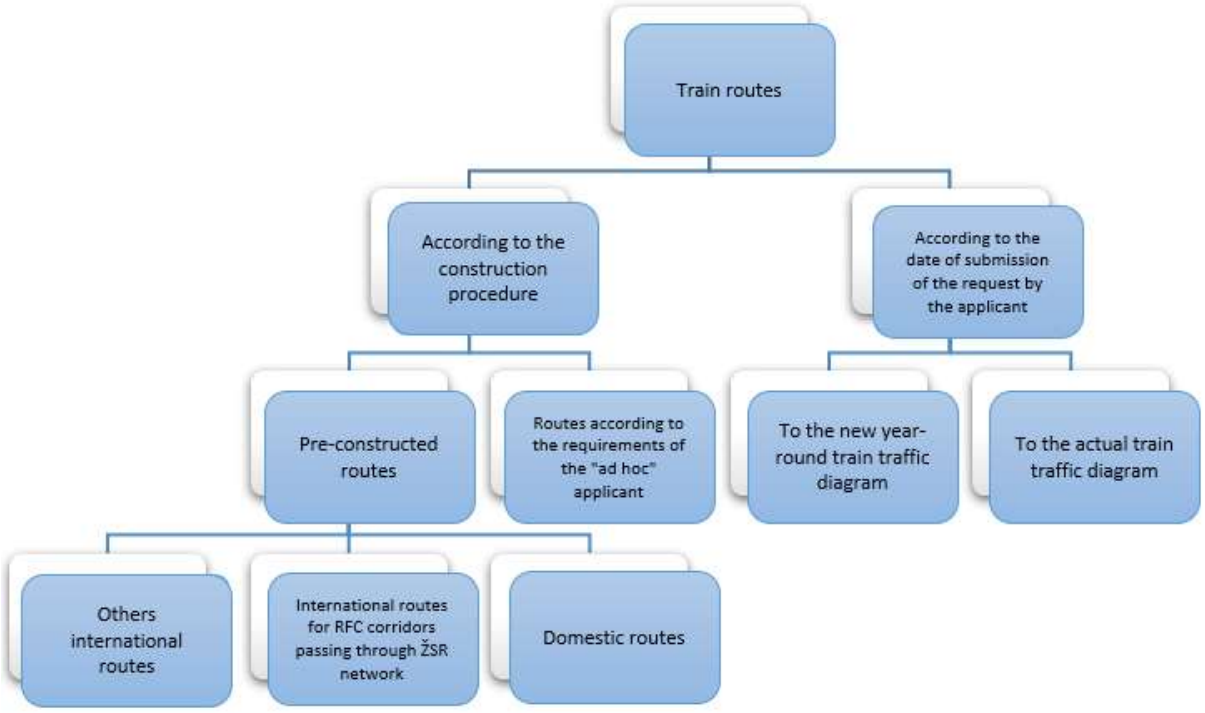


Figure 36: Division of train routes
Source: authors

Allocation of train routes in domestic transport

ŽSR, for the purpose of providing transport services on railway infrastructure, allocates railway infrastructure capacity to applicants for the period of validity of the train traffic diagram through a contract on allocation of railway infrastructure or an Agreement on the allocation of railway infrastructure capacity in the form of train paths. However, for a period longer than the validity of one train traffic diagram, it is allocated through the Framework Agreement. The methods of submitting requests for national train paths are shown in Figure 37.

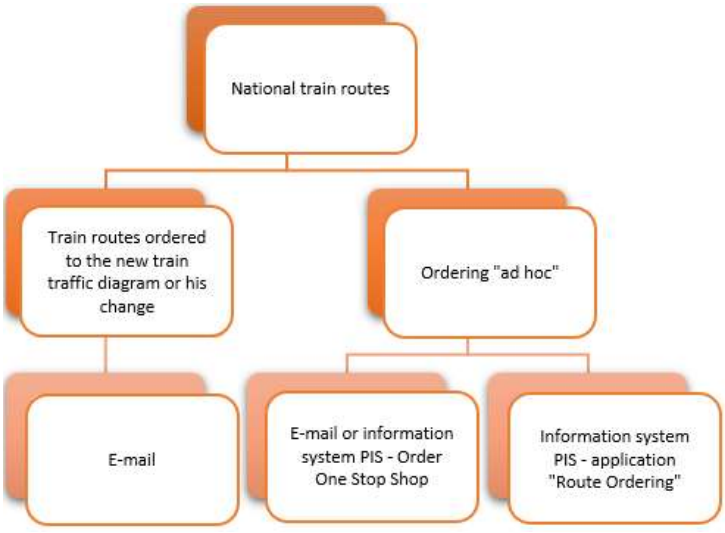


Figure 37: Methods of submitting requests for national train paths
Source: authors

Allocation of train routes in international transport

RNE also participates in the creation of the international timetable. One of its tools is "RNE PCS", which replaced the Pathfinder software tool. Its task is to ensure communication, coordination and management of the allocation of train paths. PCS supports capacity management in cooperation with Infrastructure manager. It also ensures the conflict-free planning of the entire train path in the chart and the coordination of paths by agreeing on the exact entry and exit times in border station. The methods of submitting requests for international train paths can be seen in Figure 38.

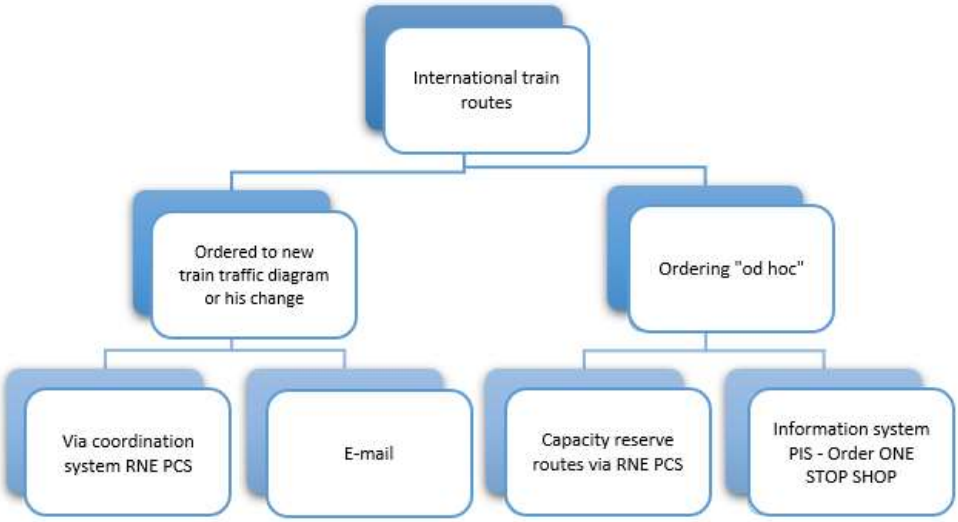


Figure 38: Methods of applying for international train paths
Source: authors

Method of submitting applications for ordering international train paths to the new train traffic diagram and to the change of the valid train traffic diagram - only applications made through the European electronic communication system PCS will be accepted. "Ad hoc" orders will only be accepted by requests through the operational information system (hereinafter referred to as PIS) via the One Stop Shop Order application. The request to activate the train route as needed, assigned to the railway company in the valid train traffic diagram, is entered through the PIS using the Simplified order application.

In the case of "ad hoc" requests, infrastructure manager is obliged to respond to the received request within five days at the latest. The provided information on the available free capacity of the railway infrastructure must be available to all applicants who may wish to use its capacity. Where necessary, infrastructure manager will assess the need for reserve capacity to be available within the final planned train traffic diagram to respond quickly and flexibly to foreseeable "ad hoc" requests for rail infrastructure capacity. This also applies to overloaded infrastructure (Directive EP and R 2012/34/EU, 2012).

In Hungary, Rail Cargo Hungaria is the only company offering nationwide single wagonload services. Service trains at the railway centres necessary to manage the traffic (trains running between the railway centres and stations on the railway line, collecting/distributing wagons dispatched/accepted at the stations), siding service trains and so-called fast freight trains running between railway centres are planned on the basis of customer needs and experience gained in connection with the service provided in previous years. Train paths are ordered on an annual basis and according to the Hungarian Network Statement, the order must be placed by the second Monday in April preceding the timetable year.

However, it is very difficult to forecast accurately for 1.5 to 2 years - customers can often only plan their transport needs up to 1 month in advance. As a result, ordered train paths and other resources (locomotives, drivers, crews) often become redundant - there are simply no wagons to handle and forward.

***Good practice**: in Hungary, railway companies can cancel the train paths they have already ordered free of charge. RCH continuously monitors customer demand and cancels the train paths (and other resources) ordered for single wagonload traffic if there are no wagons to be forwarded. This results in significant cost savings, which increases the efficiency of SWL traffic.*

2.4. Financing

In addition to subsidies for carriers, the state also provides subsidies to infrastructure managers. These subsidies are not allocated directly to regional railway transport, as they are provided for the entire railway network and for total transport performance (passenger and freight transport). Subsidy for regional transport can be determined based on the share of kilometres of regional railway lines from the total railway network and the share of total train kilometres. For the infrastructure manager, the economically justified costs are not only covered by a subsidy from the state, but also by payments for access to the railway infrastructure in accordance with the applicable regulatory framework, revenues from other business activities and in the case of a reduction in payments for access to the railway infrastructure in accordance with Resolution of the Government of the Slovak Republic no. 390/2013 also by compensating this reduction in payments from the state.

2.4.1. Increasing internal company efficiency

Single wagonload transport system must be continuously monitored and evaluated by the railway undertaking and, if necessary, the system must be modified. By increasing efficiency and offering a range of services tailored to demand, costs and financing needs can be reduced.

RCH monitors also on an ongoing basis the factors influencing the organisation of single wagonload transport service and the forwarding order of consignments. These factors are the following:

- whether certain service points (handling points) have changed,
- whether the types of goods served have changed compared to the previous situation,
- whether the customer concerned requires a change in the delivery pattern (e.g. a change of delivery day(s), a change in the number of deliveries),
- whether a change in the routing table on the forwarding route of the wagons (from marshalling yard to marshalling yard, containing the number of wagons set to another train between the two marshalling yards) is required based on the changed needs (volumes, forecasts for specific traffic days),
- change the number of domestic express trains between marshalling yards (weekly average),
- modification of the submission of annual/annual supplementary train path orders taking into account the changes to the Network Statement, Performance Scheme and Network Access Contract rules,
- changes in service technology due to the introduction of newly hired traction vehicles into the market (change of towing gender and/or train load, more reliable service, higher availability),
- whether the shunting staff previously provided by the infrastructure manager are available to carry out the services to the required standard,
- rescheduling of paths/services due to planned or foreseeable track closures.

2.4.2. Possibility of State aid

The legislative basis for obtaining state aid can already be found in the Treaty on the Establishment of the European Community (hereinafter the Treaty), where in Article 87 par. 1 of the Treaty states that "aid granted by Member States which may distort competition by favouring certain undertakings or productions is, in principle, incompatible with the common market in so far as it affects trade between Member States". In article 87 par. 3 of the Treaty, however, the situations in which the aid may be compatible with the common market are listed, some of which also apply to the transport sector.

In rail freight transport, state aid can be provided for the needs of transport coordination, which can take several forms, such as:

- aid for the use of infrastructure, aid granted to railway undertakings which cover expenses related to the infrastructure they use, while undertakings providing transport services using other modes of transport do not bear such costs,
- aid to reduce ancillary costs, which is intended to support the shift to rail transport, as this mode of transport requires fewer ancillary costs than other modes such as road transport,
- aid supporting interoperability to the extent that it corresponds to the need for transport coordination, aid supporting the strengthening of security, the elimination of technical obstacles and the reduction of noise,
- aid for research and development corresponding to the needs of transport coordination (EC Directive, 2008/C).

For obtaining state aid for the SWL segment, the following are relevant from the previous points:

- aid for the use of railway infrastructure,
- help to reduce ancillary costs.

The maximum amounts of aid, which are determined in the EC Guidelines, apply if the aid in question is financed entirely through state resources or in whole or in part through Community resources. The aid allowed under this guideline cannot be combined with other state aid within the meaning of Article 87 par. 1 of the Treaty or with other Community funding, if the sum reaches a higher aid level than the level established in the EC Directive (EC Directive, 2008/C).

Due to its complex cost structure with high fixed costs that cannot be covered by revenue alone, SWL is economically very sensitive and cannot be maintained without state aid. In EU member states such as Italy or Spain, which do not subsidise SWL, SWL has already withdrawn completely or is in the process of withdrawing; their rail modal share is correspondingly well below the EU average (2022: ES 4%, IT 12%). In other EU member states such as Germany and Austria, on the other hand, the state subsidises SWL, for example through operating cost subsidies and/or a reduction in track access charges, which is why SWL is currently still in operation in these countries.

State aid provided through network access charges

In Hungary, such support existed in the past, and although it helped rail freight companies, it did not achieve the objective of stabilising or slightly increasing the volume of rail single wagonload freight transport. Since the services provided by the infrastructure manager for the shunting activity were subsidised, railway undertakings which did not use the infrastructure manager (MÁV/GYSEV) for shunting services or used it not only for their single wagonload traffic also benefited from the subsidy, while those which provided the

shunting service themselves or used it from another service provider did not. The capacity available for the provision of shunting services has been significantly reduced by MÁV Zrt. in the light of the utilisation figures. As a result, railway companies transporting single wagonloads by rail have been increasingly using shunting services from other operators, which are not eligible for State aid and therefore have higher tariffs.

Targeted (direct) state aid in Hungary

Target:

Maintaining the share of rail transport and encouraging a further modal shift from road to rail, combined transport and inland waterways by offsetting the effects of the additional costs of rail transport, thereby reducing road transport activities and protecting the environment by promoting more environmentally friendly modes of transport.

Arguments for the justification of SWL traffic:

- to meet EU and national transport policy objectives to increase rail's market share, to favour more economical use of energy and environmentally friendly modes of transport;
- on the state side, single wagonload rail freight can be operated at lower overall costs (employment, environment, sustainability) than other modes of transport, if it were to be abandoned;
- the operation of the rail single wagonload system provides jobs and livelihoods for the employees of many rail service providers (infrastructure managers' marshalling yard, station and shunting staff, train dispatchers; traction unit staff in the case of traction providers; staff in freight wagon maintenance workshops; executive staff of freight railway undertakings (locomotive drivers, wagon inspectors, train dispatchers, storage staff)
- the performance of rail single wagonload freight contributes to higher utilisation of rail track capacity;
- provides rail transport opportunities for many small and medium-sized enterprises, thus contributing to their international competitiveness. Their consignments that do not reach the length of a full train can be transported by rail, allowing them to supply their domestic and international markets with materials, components and semi-finished products, or to use imported goods (raw materials, stocks) in their production processes;
- ensures the continuous rail service of state-owned and/or strategically important companies, thus contributing to the smooth production of and access to products and services of key importance for the national economy;
- keeping dangerous goods transported by rail in single wagonload traffic on the railways is in the interests of society as a whole, as their transport by rail is safer and more controlled;
- the emergence on roads of the volume that can be covered by hundreds of thousands of extra trucks per year would lead to a significant increase in road maintenance and renewal costs (national and municipal); at the same time, the utilisation of the renewed/upgraded rail network, with significant EU funding, would be reduced (maintaining or increasing rail traffic volumes is the objective of EU transport development tenders);
- with the disappearance of single wagonload transport, the road transport network would require substantial upgrading, which, given the EU's railway-friendly transport policy, would be possible only through the provision of domestic funding and development loans;

- shifting rail single wagonload freight to road transport would further increase external costs (noise and air pollution, congestion, accidents and their associated costs), which society would have to bear and pay ('polluter pays' principle not applied in practice).

Presentation of the Hungarian aid scheme

The duration of the Aid Scheme, approved by the European Commission (SA.59448 2020/N), is from 1 June 2021 until 31 December 2025.

The aid takes the form of non-refundable grants and includes two sub-measures, namely aid for reducing external costs and aid for rail infrastructure use.

In relation to aid for reducing external costs the eligible costs are the part of the external costs that rail freight transport makes it possible to avoid compared to road freight transport. In relation to aid for rail infrastructure use, the eligible costs are the additional costs for infrastructure use paid by rail transport but not by a more polluting competing transport mode.

Hungary calculated the eligible costs based on a study performed by the research and consulting company KTI Institute for Transport Sciences Non Profit Ltd. To this end, average door-to-door costs for both road and rail were calculated, basing the methodology on the Commission's Handbook on the external costs.

Based on the KTI study, the eligible costs related to external costs are calculated as the difference between the total external cost of road freight and the total external cost of rail freight (SWT segment), as shown in Table 10.

	Road	SWT	Difference (road external costs surplus to SWT)
Accidents	3.51	0.48	3.03
Air pollution	2.82	0.23	2.60
Environment change	1.82	0.09	1.73
Noise	1.47	0.52	0.95
Congestion (additional time)	0.70	0.00	0.70
Energy production	0.66	0.37	0.29
Environmental degradation	0.96	0.67	0.28
Total	**11.94**	**2.35**	**9.59**

Table 10: External costs of freight transport, HUF/net tonkm
Source: KTI study, 2018

In the KTI study, the values used by Hungary for SWT in Table 10 were calculated by combining the values presented in the Commission's handbook for electric traction (in amount of 89%) and diesel traction (in amount of 11%), reflecting the split between those traction types, and converting the results from EUR to HUF.

According to the KTI study, for the calculation of the total cost of rail transport and the use of infrastructure costs for both rail and road freight transport, Hungary created a standard cost model in order to assess the results required for the comparison. The KTI study took into account various expenses for rail transport (such as fee of access to network / use of railway; traction fees; shunting / arranging charges; wagon park and service expenses etc.) and for road transport (such as tolls; vehicle related taxes, insurance fees; other expenses related to the operating of the vehicles etc.). As the result of the cost calculation, the unit cost of rail transport in tonkm was obtained (see Table 11 for the results).

Single wagon load train	Forwarding capacity (million net tonkm)	Total cost of railway transport (million net tonkm) / forwarding capacity (HUF/net tonkm)	30% of total cost of railway transport (HUF million)	Infrastructure use cost difference 100% (HUF/net tonkm) (a)	External cost difference 100% (HUF/net tonkm)	External cost difference 50% (HUF/net tonkm) (b)	Max aid amount, (HUF/net tonkm) (a+b)
Domestic	450.1	50.93*	6 877.9	3.58	9.59	4.8	8.38
Import+ Export	1 050.1	34.36**	10 824.9	0.15	9.59	4.8	4.95

Table 11: The calculation of maximum allowed aid amounts (in HUF, costs refer to 2018)

** The value for domestic total cost of railway transport without taking into account the forwarding capacity is HUF 22 926.3 million.*

*** The value for import+export total cost of railway transport without taking into account the forwarding capacity is HUF 36 083.1 million.*

The aid amount is determined on the basis of the net tonkm performed on the Hungarian open access railway infrastructure network in the single wagonload traffic. The maximum aid amount is different for domestic SWT traffic and export/import SWT traffic.

Aid amount (HUF/net tonkm, EUR/net tonkm*)		
Type of traffic	up to 80 km**	above 80 km
Domestic	8,38 / 0,02294	8,38 / 0,02294
Export/Import	4,95 / 0,01355	4,95 / 0,01355

Table 12: Aid amounts available for SWT on the Hungarian open access railway infrastructure

** The aid is disbursed in HUF. The EUR amounts are based on the official medium exchange rate of the National Bank of Hungary on 24 September 2020 (HUF 365.33/EUR) and are for information purposes only*

***This aid applies only to the distance taken by the wagon from the place of dispatch (service) by the first train to the last train before the destination (service) on the Hungarian open-access railway network. Transporting the wagon to or from a border crossing does not count as the first or last carriage by train.*

Aid intensities under the Hungarian aid scheme:

(a) 100% of the eligible costs for aid for rail infrastructure use and

(b) 50% of the eligible costs for aid reducing external costs

According to the aid scheme, a single wagon load is a consignment dispatched by a freight wagon transported on more than one train path, the distance between the first and/or last train path is maximum 80 km and the maximum weight of consignment is 2 000 tonnes. The first or last train path shall be considered to be the train path on which, before/after carriage of the wagons, the loaded/unloaded state of the wagon has changed (including the loaded state) or the number of items (NHM) has changed. Another requirement is that

- the composition of the trains on all the lines concerned cannot be identical,
- there are no interruptions between the loading and unloading stations of the lines concerned,

- maximum 10 train paths are used,
- the consignment is not in transit (the first and last points of the carriage are not border crossings in either case)

Single wagonload rail transport: the transportation of a consignment as defined above between the station of dispatch and the station of destination on the open access railway network in Hungary.

No aid is payable for the transportation of a consignment in transit (through traffic), for the transport of empty wagons (goods loaded in wagons weighing less than 1 tonne) and for the transport of wagons running on their own wheels.

The body providing the support (the Sponsor) is MÁV Zrt. on the basis of an agreement with the competent ministry (granting Authority). Based on the availability of data, service contracts and accounts, the Sponsor could practically be any Hungarian infrastructure manager. The Sponsor draws up and publishes on its website a call for applications for participation in the scheme, including all the information, conditions and forms necessary for participation in the procedure.

The aid is awarded on a competitive basis to all Applicants who apply and meet the conditions set out in the call for proposals. The evaluation of the application is carried out on a non-discriminatory basis. The aid is awarded on the basis of an application and is utilised through the conclusion of a Framework Subsidy Agreement between the Sponsor and the Final Beneficiary.

The aid is paid on a monthly basis, based on actual performance, uniformly for the Hungarian railway network.

The Final Beneficiary is required to submit to the Sponsor an annual technical report, including the volume of freight transported by rail in each wagon, and accounting for the amount of aid paid during the year in question. The Sponsor is required to carry out an evaluation of the achievement of the intended objective (including the contribution to maintaining or increasing the volume transported).

In 2022, HUF 6.4 billion (EUR 16.75 million) was available under the scheme, almost all of which was used (99.58%). Five railway companies applied to participate in the scheme, and MÁV concluded the framework contract with all five. All of them carried out single wagonload transport, as defined in the scheme, with the following shares of performance:

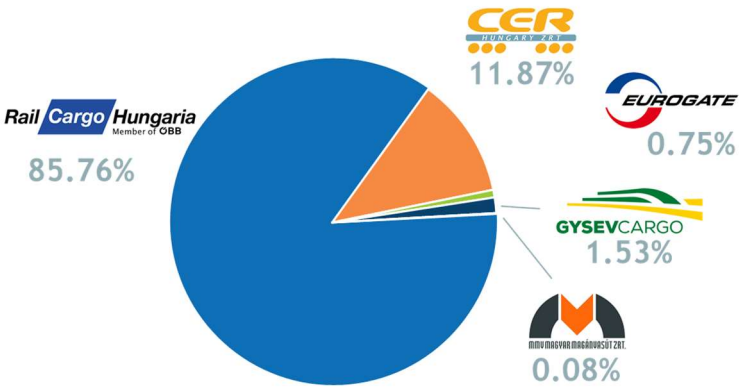


Figure 39: Breakdown of SWL traffic between railway undertakings in Hungary
Source: MÁV Zrt.

Targeted state aid in Slovenia

One of the key steps in order to develop and increase the volume of single wagonload transport in Slovenia, the necessary involvement and support of the state with financial incentives in the form of dedicated budget resources, but it is also necessary to carry out a modernization of the railway infrastructure, including the renovation of the terminals for combined transport.

Railway line	Work done (Ntkm)
Celje-Rogatec	13.925.827
Celje-Velenje	8.834.934
Maribor T.-Prevalje	7.811.433
Maribor T.-Murska Sobota	10.544.866
Dobova-Zagorje	36.371.421
Lj. Moste-Kamnik Graben	27.622.479
Lj. Moste-Kranj	12.615.352
Lj. Zalog-Ilirska Bistrica	48.917.088
Lj. Zalog-Kočevje	11.612.057
Lj. Zalog-Novo mesto	27.285.558
Jesenice-Bled Jezero	1.696.492
Nova Gorica-Most na Soči	38.792.382
Nova Gorica-Ajdovščina	3.154.214
TOTAL	**249.184.103**

Table 13: Single wagonload transport in Ntkm in Slovenia in 2017

The production costs of these transports in 2017 amounted to EUR 22.1 million, which means EUR 89/1000 ntkm, the market revenues received in the same year for these transports amounted to EUR 13.2 million, which is EUR 53/1000 ntkm, the difference is a negative business effect in the amount of EUR 8.9 million, that means a EUR 36 deficit for every 1000 ntkm of transport performed.

In the field of rail freight transport, multi-year state aid programs are provided in EU countries to co-finance the services of accompanied and unaccompanied combined road-rail transport and single wagon transport, as these types of freight transport generate higher total transport costs on the "door to door" route. Costs compared to only road transport or direct rail transport, and therefore cannot successfully compete with them on the market without financial support, which is why they would not be implemented in these countries. At the same time, the transport of goods by road causes significantly higher external costs to society than rail transport and emits significantly higher amounts of greenhouse gas emissions into the environment, which has an extremely negative impact on the environment and the worse position of Slovenia in achieving internationally agreed goals in the field of environmental protection and reducing total of greenhouse gas emissions.

In November 2019, a working group was appointed by the Ministry of Infrastructure with the task of preparing starting points and proposals for measures in the field of transport and environmental protection, which will stimulate the use of rail transport of goods at the expense of reducing the transport of goods by road and contribute to the reduction of greenhouse gas emissions and environmental protection.

Also, Slovenian Government (Ministry of Infrastructure of Republic of Slovenia), recognising the danger of the disappearance of single wagonload rail transport and all the negative consequences of this, decided to establish a system of subsidies for single wagonload rail freight transport by Government Decision. Following approval by the European Commission (State Aid SA.62208 (2021/)-Slovenia), the scheme was introduced

from the end of October 2021. The introduction of the aid scheme has created the prospect for the survival of this transport segment, which is also important from an environmental, economic and social point of view.

2.1. Objective and main characteristics

(4) Slovenia intends to promote sustainable freight transport as part of the National Climate Change Fund through subsidies to support the modal shift from road to rail by increasing the volume of goods transported by rail.

(5) Railway undertakings active in the rail freight sector face not only competition by road transport, but also higher costs due to the complexity of the transport chain. According to Slovenia, the current market environment is not sustainable in terms of economic viability, as the rail freight undertakings have been continuously suffering significant losses amounting to several million EUR per year.

(6) The aim of the measure is to provide support to undertakings providing two types of rail transport: first, the transport of goods by single wagon transport ("SWT") and, second, the combined road-rail transport of goods ("combined transport").

2.4. Duration and budget

...

(12) The duration of the scheme will cover the period from the date of the publication of the public call to 31 December 2023.

(13) The total budget of the scheme will be EUR 15 million. The aid will be disbursed in 2022, 2023 and 2024 on the basis of actual operated kilometres during the above-mentioned period.

2.3. Beneficiaries

(9) The eligible beneficiaries are railway undertakings, which hold a valid license from a Member State of the European Union or European Economic Area. Further, the beneficiaries must perform transport activities by rail in Slovenia or are about to perform such activities[3], and must pay railway infrastructure charges in Slovenia. Both domestic and foreign based undertakings have access to the aid under the same conditions and without discrimination.

(10) Slovenia estimates that the number of beneficiaries will be below 10 undertakings.

Table 3: Calculation of maximum aid amounts in EUR per 1,000 tkm

	Operated tkm (2017)	Total costs of rail transport	30% of total costs of rail transport	Eligible costs per 1,000 tkm	50% of eligible costs	Maximum aid amounts
SWT	249,184,103	88.68*	26.607	16.075	8.0375	**8.0375**
Combined transport	1,609,447,211	27.89**	8.369	16.075	8.0375	**8.0375**

**(22,100,000/249,184,103)*1000*
***(44,900,000/1,609,447,211)*1000*

(21) Slovenia will grant a maximum aid amount of EUR 8.03875 per 1,000 tkm for SWT and a maximum aid amount of EUR 4.48 per 1,000 tkm for combined transport.

(22) On the basis of the above, Slovenia submits that the measure respects the following maximum aid intensities:

(a) 50% of the eligible costs for aid reducing external costs for SWT.

(b) 28% of the eligible costs for aid reducing external costs for combined transport.

Figure 40: Scheme of state aid in Slovenia
Source: Eropean Commission SA.62208

At the request of the Slovenian authorities, the European Commission extended the scheme for a further two years until 31 December 2025 (SA.107235). The budget under the notified measure is EUR 17.5 million. The Slovenian authorities confirmed that, except for its duration and budget, all other features of the aid scheme will remain unaltered.

Slovakia

In Slovakia, a study aimed at the preparation of state support for SWL was recently completed.

The maximum possible intensity of state aid was determined based on the calculation:

- 30% of operating costs of railway transport,
- 100% of the cost difference for using the infrastructure.

Operating costs in individual transport modes are calculated in Table 14 for a transport capacity of 1,097.2 million net tonne kilometres (95% of ZSSK CARGO performance, 5% performance of other railway companies providing SWL services). For individual transport modes and commodities, this performance was partially divided according to the share of these commodities in individual ZSSK CARGO transport modes. The amount of the maximum intensity of authorized aid based on operating costs is 17.46 million € (table 14).

Transport mode	Commodity				Total	30% of the total cost
	Wood	Metals	Chemistry	Others		
Import	1.41	4.73	1.66	2.81	10.62	3.18
Export	7.22	7.62	1.03	2.27	18.13	5.44
Transit	0.19	1.78	1.44	0.55	3.96	1.19
Domestic	12.66	8.58	0.94	3.32	25.49	7.65
Total	21.48	22.71	5.07	8.95	58.21	17.46

Table 14: Operating costs of railway transport in the SWL segment in millions €.

The maximum amount of state aid based on the EC Guidelines can be in the amount of 100% of the difference in costs for the use of road and railway infrastructure.

External costs for rail transport based on the current performance of SWL

The current SWL transport performance in 2021 of the majority operator ZSSK CARGO was 1,042 million net tonne kilometres, which represented approximately 95% of all SWL performances. For the calculation of external costs, the transport capacity of SWL in the amount of 100% was used. External costs for rail transport according to individual modes of transport are shown in Table 15.

Transport mode	Total external costs in mil. €	Unit external costs in €/thousand. net tonne kilometres
Import	3.430	16.70
Transit	1.414	13.87
Domestic	8.257	21.78
Export	6.259	15.24
Together	19.361	17.65

Table 15: Total and unit external costs of rail transport when transporting SWL.

Principles and specifics of cost calculation

The calculation of authorized costs for supporting the transport of SWL is based on a generally valid methodology for cost calculation in road and rail transport, as well as for the calculation of external costs. Because railway transport is more technologically demanding compared to road transport, the cost rate methodology was used in the calculation of operating costs and costs for the use of railway infrastructure, which allows for a more precise quantification of individual cost items for a specific product (in this case SWL).

The following cost items were considered when calculating the operating costs of SWL in rail transport:

- traction energy costs,
- locomotive costs,
- wagon costs (including costs for the wagon stay on the siding),
- costs of executive employees (train drivers, train crews),

- fee for the use of railway infrastructure,
- shifting costs (all costs related to shifting, locomotive costs, traction energy, locomotive crews, shifting reserve),
- costs of locomotive trains (all costs related to locomotive trains, costs of traction energy, locomotive, use of railway infrastructure, locomotive crews),
- transhipment costs,
- costs for train drivers,
- costs of commercial employees,
- commercial overhead,
- company-wide management.

When calculating the maximum amount of state aid for the use of the infrastructure, all costs related to the use of the railway infrastructure were taken into account for rail freight transport, the cost of a minimum access package, access to marshalling stations and train marshalling facilities, including shunting facilities and access to freight terminals, the use of sidings set aside for the temporary parking of wagons between two tasks, and the cost of extraordinary ancillary services provided by the infrastructure manager. Given that in ZSSK CARGO's information systems, only fees for the minimum access package are tracked for SWL transports, the other items were partially recalculated according to the average share of all transports carried out by ZSSK CARGO. These costs would be even higher considering that SWL transportation is largely carried out by Mn trains that use train marshalling facilities in several railway stations (change of train composition). The calculation of costs for the use of infrastructure in road freight transport considered the costs of tolls (toll fees) and motor vehicle tax, the proceeds of which are to be used for the operation of land roads in the National highway company administration. Toll costs were calculated based on the proportional use of the tolled and non-tolled road network.

The resulting calculation for the SWL segment

To quantify the maximum amount of state aid, it was necessary to perform a calculation:

- 30% of operating costs for rail transport,
- 100% of the difference in infrastructure use costs between road and rail freight transport,
- 50% of the difference in external costs for road and rail freight transport.

The maximum amount of state aid for the SWL transport segment is as follows:

- infrastructure costs – 7.43 mil. €,
- ancillary external costs – 10.33 mil. €.

The maximum amount of state aid for the SWL transport segment, according to the differentiation into transport modes, is as follows:

- domestic transport – 5.155 mil. €,
- international transport – 12,611 mil. €.

The transport of SWL in Slovak conditions can be supported both from the point of view of the costs of using the infrastructure and from the point of view of reducing external costs. The total amount of the maximum intensity of state aid for the transport of SWL can be 17.77 million €.

Proposed measures supporting the maintenance of the SWL segment

Reduction of SWL transport performance or ending the transport of this segment by rail transport (with a 100% transfer of transport to road freight transport) would mean a significant increase in the burden on the environment and the health of the inhabitants. Therefore, it is necessary that this segment be supported by state aid in compliance with the conditions set by it or will be determined by the European Commission in the future.

Other measures that would reduce the costs of transporting the SWL by rail, and therefore also increase the attractiveness of this segment of transportation, can be divided into two groups:

- measures implemented by entities outside the company providing SWL transport services,
- measures implemented in a company that provides SWL transport services.

The measures implemented by entities outside the company providing SWL services primarily include:

- investment measures in railway infrastructure – electrification of railway lines, given that external costs for diesel traction are almost four times higher than for electric traction and at the same time operating costs are lower for electric than for diesel traction,
- support in the form of direct and indirect state aid for the purchase of locomotives with alternative drives (hydrogen drive, drive using an accumulator in combination with power from a traction line, etc.),
- introduction of the obligation to connect newly built industrial parks and logistics centres to the railway infrastructure (if it is profitable),
- maintenance, restoration, modernization, expansion of the infrastructure for loading and unloading goods (support of sidings, infrastructure in stations, etc.),
- introduction of the shift service in stations as a service in the public interest, which will be provided on a non-discriminatory basis,
- other support for maintaining and increasing the transportation of the SWL segment by rail freight transport based on the conditions of the European Commission.

The measures implemented in the company providing SWL services should be aimed primarily at:

- vehicle fleet using wagons causing less noise,
- use of locomotive with alternative drives, or the use of locomotive diesel traction with the Stage III B category (according to the UIC categorization, these are locomotives whose production year is after 2011), which cause a significantly lower environmental burden,
- assessment of the efficiency and possible change of the technology of carriage and service of the tracks,
- introducing the so-called "regional trains" (formation of a complete train by gradually connecting wagons in several stations in the relevant regional area without the need for further processing of the train on the transport route to the unloading station),
- grouping the loading of wagons into a smaller number of stations with the aim of increasing the efficiency of the operation of individual tariff points,
- provision of complex logistics services (including collection and delivery),
- increasing the efficiency of use and productivity of the work of the operating staff,
- streamlining the performance of shifting and operating handling points,

- introduction of new Informatic technology tools according to customer requirements and business needs.

Despite the study submitted by AROS, the Ministry of Transport did not approve the aid. The carriers have not received any feedback from the Ministry of Transport, but they are constantly trying to push for the proposed form of aid. Currently, there have been several personnel changes in the Ministry, so the carriers will try to organize a meeting on the state aid for single wagon loads with the new Ministry officials.

2.5. Digitalization

2.5.1. E-consignment, e-invoice

The use of electronic consignment notes (e-consignment notes) in rail freight transport offers several advantages over traditional paper-based consignment notes. With e-consignment notes, the processing time for documentation is significantly reduced compared to manual paperwork. This results in quicker handling and transit times for rail freight shipments. Automation reduces the likelihood of errors that can occur with manual data entry or paper-based processes. This improves the accuracy of information related to shipments, reducing the risk of mistakes that could lead to delays or disputes. Electronic systems often include validation checks to ensure that the information entered is accurate and complies with regulatory requirements. This helps maintain data integrity throughout the transport process.

The shift to electronic consignment notes eliminates the need for physical paper, reducing costs associated with printing, storage, and transportation of paper documents.

Streamlining processes with e-CNs can result in cost savings through improved operational efficiency and reduced administrative overhead, at the same time it increases the quality of rail transport, thus SWL traffic, and makes the service more attractive to customers.

Blockchain in the supply chain

The supply chain is exposed to various risks: delays, losses and damage. Blockchain allows for quick identification and resolution of problems, minimizing the effects on the entire delivery process. Blockchain enables the creation of an immutable, cryptographically protected ledger in which each stage of the supply chain can be recorded. This ensures full transparency and the ability to track each transaction, which is especially important in the case of food or pharmaceutical products.

Blockchain makes it easier to store and manage all documents related to the supply chain, such as contracts, invoices and certificates. This eliminates the need for paper documentation and reduces the risk of losing important information. Smart contracts, i.e. computer programs running on blockchain, can automate various processes in the supply chain.

It is easier for consumers and businesses to verify the origin of products when every transaction is recorded on an immutable blockchain. This is especially important in industries where the authenticity and quality of products are crucial. By eliminating bureaucratic processes and enabling immediate verification of information, blockchain can help shorten delivery times.

2.5.2. Monitoring (track and tracing)

Monitoring, tracking and tracing are crucial aspects of rail freight transport for several reasons, contributing to the efficiency, safety, and overall success of the logistics process.

Monitoring allows stakeholders to have real-time visibility into the location and status of freight shipments. This visibility is essential for shippers, carriers, and other parties involved in the supply chain to make informed decisions and respond promptly to any issues or delays.

Timely and accurate information on the status of shipments contributes to better customer service. Shippers and customers can receive timely and accurate information about the status of their shipments, allowing them to plan and manage their logistics more effectively. This transparency builds trust and satisfaction among customers.

Tracking and tracing systems provide valuable data that can be used to analyze and optimize operations. By understanding the movement of freight, rail operators can identify bottlenecks, streamline processes, and enhance overall efficiency.

Accurate monitoring helps in better planning and scheduling of rail freight movements. It enables operators to anticipate potential disruptions, allocate resources effectively, and plan maintenance activities to minimize downtime. By tracking the usage and condition of rail assets such as locomotives and rolling stock, operators can optimize their utilization. This involves scheduling maintenance based on actual usage patterns rather than fixed time intervals, reducing downtime and maintenance costs.

Monitoring systems enhance the security of rail freight by providing real-time information about the location and condition of shipments. This is crucial for preventing theft, ensuring the safety of high-value goods, and implementing appropriate security measures.

In the event of accidents, emergencies, or natural disasters, real-time monitoring provides critical information for emergency response teams. This allows for a quicker and more effective response to incidents, minimizing the impact on both human safety and the environment.

The use of transponders for railway logistics

Transponders play an important role as advanced identification and monitoring tools. These devices, using radio technology, are capable of transmitting data wirelessly, enabling effective identification, location and tracking of individual wagons or shipments. This tool is becoming an integral element of effective and integrated logistics in the context of rail transport, including single-wagon shipments.

Options offered by the railway companies

ZSSK CARGO customers have access to a customer portal through which they can access various electronic services. Through the portal, customers have access to the regulations and tariffs of ZSSK CARGO, can conclude a transport contract (electronic consignment note), place a transport order (electronic transport order), track the location of wagons and shipments (this service is offered to customers for a fee, while customers have access to information about the current location of wagons on the ŽSR network).

The company also offers its customers the opportunity to use the electronic document office, which can be used for electronic invoicing (a repository of electronic invoices) and electronic orders for the sublease of freight wagons.

RCH also has an electronic customer relationship management system (e-freight), which enables the mutual exchange of information in electronic form throughout the technological process of rail freight transport. E-Freight facilitates communication between customers and the railway company through a user-friendly and easy-to-use interface, accessible 24 hours a day via the Internet.

The system is modular, with different modules available for different phases of the freight transport process.

I. Preparation of the transport

Tariff calculation: allows the preliminary calculation of freight of consignments on rail and the calculation of the distance between two inland tariff points.

Transport Restrictions: Queries and content of Freight Transport Restrictions (FTR) imposed by Rail Cargo Hungaria are available in this module.

Discount management (E-Discount): The module provides easy-to-fill forms and downloadable templates to help customers request offers, manage and view offers and tariffs already issued.

II. Process of freight forwarding

Wagon Ordering: customers can place their wagon orders electronically, the module also allows customers to view the arranged wagon registration number and wagon details of their wagon order, and also to track and follow wagon forwarding events until the servicing of the wagon for loading.

Consignment documents: this module allows the customers to record their consignment note data electronically in Rail Cargo Hungaria's system with the help of easy-to-fill forms and downloadable templates, which eases and fastens the process of sending consignment notes. The consignment note data can be stored in PDF and XML formats, making it easier and faster to retrieve old consignment notes. The files contain every data that is included in the paper-based consignment note and can be processed electronically.

FREIGHT INFO: the partners can keep track of the movement and the actual location of the wagons and trains employed in the carriage of their consignments. This data is iscontinuously updated, and provides information about the condition of the wagons, the date and time of border-crossings as well as the status changes regarding owned or rented wagons.

FREIGHT INFO Batch: RCH creates and sends freight information queries to the clients in previously specified regular intervals and with pre-defined data-content. The data-content of the Batch queries are defined by the client, the one-time expenses of the development of the query process is borne by the client.

III. Process of invoicing

INVOICE INFO: in this module invoices prepared for the partners in PDF format and electronically processable invoice information are available. Apart from the data content of invoices, the module INVOICE INFO contains additional data to support invoice processing. Data files can be used for various tables-or invoice-processing softwares as well.

E-Invoice Complaint: this module makes the management of invoice-related complaints faster, more convenient, and easily traceable.

CURRENT ACCOUNT INFO: this service offers daily account statements to the partners of their accounts managed by Rail Cargo Hungaria.

Customer feedback: this module allows the customers to contact our system support staff directly, request information, report errors or file complaints and also to monitor the progress of their previously filed cases.

Services of the E-Freight system are free-of-charge, only the development of the FREIGHT INFO Batch has a one-time expense.

2.6. Staff

2.6.1. Shunting staff, engine crew, wagon inspector

A crucial point for rail freight transport is the lack of skilled labour force. The average age of people working in the railway sector is high, many are approaching retirement age, while there is a shortage of young and skilled workforce who might be attracted to the railway. Lengthy, very complex training, education and examinations also put them at a competitive disadvantage compared to the road transport sector, where the requirements are lower and take less time to meet. This is costly and resource-intensive for both infrastructure managers and railway undertakings. It has also an impact on other players in the economy, because operating siding means meeting similarly high requirements, almost at the level of open line railway operators.

Single wagonload transport is a particularly labour-intensive segment of rail freight transport, where the shortage of skilled workforce is particularly acute and may even become a long-term barrier to traffic.

***Good practice**: the Hungarian infrastructure managers (MÁV, GYSEV) provide the railway undertakings with shunting crews, locomotives and locomotive crews at the marshalling yards for pre-notified charges, on the basis of a special order. In addition, they will also perform the tasks of train registration (registration of data required for preparing the total weight report of a departing train, transferring the data to the infrastructure manager's information system for recording, preparing braked weight calculation, handling the train rear end signal disc). This will greatly improve the situation for the railway undertakings, as they will not have to maintain separate staff at these marshalling yards - MÁV and GYSEV staff will perform these tasks for both freight and passenger trains. The list of marshalling yards providing the described services and the charges for these services are set out in the Network Statement.*

However, at stations where infrastructure managers do not provide these services, railway undertakings have to manage the task themselves. Since it is not economically sustainable to maintain a staff of a few people at railway stations with lower traffic and since some of the knowledge required for each job is the same, the introduction of a complex job, where one person can perform the tasks of several jobs in the course of his/her daily work, seems to be an obvious solution.

***Good practice**: in Hungary, Rail Cargo Hungaria has introduced the complex wagon inspector job, where, in addition to the traditional wagon inspector job, colleagues have acquired the knowledge required for the foreman shunter, passed the necessary exams and are now able to perform the duties of the foreman shunter. Similarly, the company employs now also complex locomotive drivers, who can perform the tasks of a wagon inspector in addition to those of a locomotive driver.*

Poland

In 2022, there was a 2.3% increase in the number of employees in the freight carrier sector, which translates into a total of 27,475 people. It is worth noting that the main player in this market, PKP Cargo, recorded a 3.1% reduction in employment, which also resulted in a 2.2 percentage point decrease in its share of the employment structure. Similar trends were also recorded at other large companies, such as PUK Kolprem and CTL Logistics.

It is worth emphasizing that the increase in employment is mainly due to smaller railway carriers that have just entered the market. Despite this overall increase, freight carriers, like their counterparts in the passenger sector, saw a decline in the number of workers employed in regulated occupations, affecting 11 of the 12 reportable job types. Thanks to the development of the market, the demand for specialists in the railway industry is increasing, which meets the demand in this area, and employees can expect higher remuneration than when working for one large company.

2.6.2. Trainings

A critical issue for rail freight is the shortage of skilled labour. The average age of people working in the rail sector is high, many are approaching retirement age, while there is a shortage of young and skilled replacements who might be attracted to the railways. Replacing an ageing workforce is essential for the sustainability of rail transport. This requires making a career in the railways attractive to young people, starting with the acquisition of the skills needed to take up a job in the railways.

In Hungary, the education sector has to provide basic training, retraining and upgrading for about 10,000 people per year and periodic training for 30,000 people. Lengthy and overly complex training, education and examinations also put the sector at a competitive disadvantage compared to the road sector, where requirements are simpler and less time-consuming. This is costly and resource intensive for both infrastructure managers and rail freight operators. It also has a knock-on effect on other players in the economy, as the requirements for the operation of private sidings are similarly demanding, almost reaching the level of those for open line railways.

Many young people are put off by the amount of material to be covered and the teaching methods. Rail training should be adapted to the learning habits of Generation Z. This generation has grown up with digital technologies such as the internet, smartphones and computers and prefers short and dynamic content. Short videos, animations and interactive content can be more effective for them than longer, traditional training materials. Railway training needs to adapt to these new trends.

Employees working in the field of freight rail transport must meet the conditions of professional competence. Professional competence can be fulfilled by regular employee training, which employees must complete at least twice a year. During this training, operating employees are informed about changes in relevant regulations, accidents that may occur during the performance of their work, but also about news from the technical and transport side. Operating employees must also undergo major retraining once every 3 years, where they must pass an exam. Table 16 shows the structure of employees of the ZSSK CARGO carrier according to the type of work.

Administration	581	14.42 %
Operation	3,447	85.58 %
Total	4,028	100.00 %

Table 16: Structure of ZSSK CARGO carrier employees by type of work
Source: ZSSK CARGO Annual Report, 2022

2.7. Benefits and allowances from the State

2.7.1. Taxation (excise duty, business tax)

Excise duties

***Good practice**: In Hungary, pursuant to Act LXVIII of 2016 on Excise Duty, a person carrying out rail passenger transport or rail freight transport is entitled to a tax refund on diesel used for these activities and for traction or shunting activities performed in connection with these activities. The amount of the tax refund is HUF 142,9 per litre.*

This tax refund contains state aid provided pursuant to European Commission Decision SA.104781 (Scheme on excise duty exemptions and refunds for fuel used in railway and inland waterway transportation 2023-2029)

According to the law, diesel used for road transport by motor vehicle or semitrailer with a gross vehicle weight of 7.5 tonnes or more may also be subject to an excise duty refund of HUF 10 per litre (if, the price of crude oil on the world market exceeds USD 50 per barrel). Pursuant to Article 44 of the Block Exemption Regulation, aid may be granted in the form of a tax refund as an environmental tax credit as defined by Council Directive 2003/96/EC.

The differentiated rate of refund means that the subsidy per tonne-kilometre is almost the same for rail and road.

However, in the case of the more environmentally friendly electric rail traction, there is currently no possibility of refunding the tax, which causes distortions of competition, and it is therefore proposed to refund the excise duty on electricity to rail freight operators in the segment of electric traction.

Business tax

In Hungary, the Local Tax Act sets out the rules for the payment of local business tax. The tax is based on the net turnover of the company (which may be reduced by the cost of materials, the purchase value of goods sold, research and development costs and subcontracted services, but these items are negligible compared to the turnover of a railway company), the tax rate is 2%.

A deduction of 7.5% of tolls paid for the use of national and international motorways and main roads is allowed up to the amount of tax payable under the law.

In order to create a level playing field between road and rail freight, it would be desirable to extend the above allowance to rail freight transport. This would also allow railway undertakings owning or operating railway vehicles to deduct 7.5% of the amount of the charge for the use of the open access rail network from the amount of the business tax.

Poland

Data obtained from reports of railway market participants show that in 2022, the total revenue from the activities of rail freight carriers reached nearly PLN 11.0 billion, which was an increase of PLN 0.7 billion compared to the costs of this activity. These values are the highest in the last decade.

In 2022, the EBITDA indicator in the rail freight sector amounted to PLN 1.81 billion, which means a significant increase compared to the previous year.

The analysis of revenues and costs in relation to the weight of transported cargo allows for the determination of approximate revenues and costs per 1 ton of cargo.

In 2022, the revenue per 1 tonne of cargo amounted to PLN 44.16, which was 19.4% higher than in 2021 (PLN 36.97 per tonne). The increase in costs per 1 tonne of cargo was smaller, reaching PLN 41.17 in 2022 compared to PLN 36.94 in 2021 (an increase of 11.4%).

The analysis of rail freight operators' expenses covers various cost categories. In 2022, the largest increases were recorded in expenditure on materials and energy (+44.7%) and in the costs of fuel and traction energy (+39.5%). Expenditures on employee benefits increased by 8.4% and the costs of access to infrastructure by 8.1%. During this time, the share of depreciation in the structure of generic costs decreased by 5.8%.

2.7.2. Financing the operation of transport infrastructure, tolls

The price offered by carriers to their customers is influenced by many aspects, and it is very important for carriers to know their costs, which affect the final price offered to customers. The price for the use of transport infrastructure is one of the most important cost items for carriers. Different charging conditions for road and railway infrastructure cause higher average unit costs in rail transport.

Slovakia

While road transport is charged for defined sections of roads I. to III. classes, expressways and highways in rail transport are charged for railway lines in full (depends on the category of the line - the lower the category of the line, the lower the price for using the transport infrastructure). Under the conditions of Slovakia, access to service facilities, use of parking tracks set aside for temporary parking of wagons, etc. are also subject to charges in railway transport, while in road freight transport there are no additional charges for carriers.

For handling trains (Mn), siding trains (Vlec) and national relay trains and 1st consecutive national relay trains is applied reduced payments of 90% of the railway infrastructure usage are applied.

Hungary

The most significant competitive advantage for road transport has been the development of infrastructure. Since the change of regime, the length of the motorway network in Hungary has increased sevenfold, which has drastically improved journey times. In addition, the existing regulatory system provides road transport with a number of other competitive advantages. While in the case of railways, the most expensive services in relative terms are the "last mile" services (such as serving the siding and public loading facilities): shunting, marshalling, change of the traction unit) and since accession to the European Union (2004) rail freight carriers have to pay track access charges for each km travelled, while road hauliers have only been subject to a per km toll since July 2013 and can continue to operate on minor roads without paying a toll. The length of the national road network is 32 522 km, of which app. 7 300 km (22.5%) is the total length of the public road section subject to toll.

3. Conclusion

Single wagon load is an important part of the services provided by freight railway carriers. This service is not only a matter of moving goods, but it is a complex process that requires efficient station facilities, qualified staff and reliable locomotives, wagons, and other technical infrastructure.

Support for freight transport in the form of state aid, legislative measures and other forms of state support is crucial for the maintenance and development of this services. Without adequate support, the efficiency and competitiveness of this service will decrease. Ensuring adequate support is therefore essential for its maintenance and development.

Another key requirement for the long-term sustainability of single wagonload traffic is the maintenance of the international network. The size of European countries, especially in Central and Eastern Europe, means that domestic rail transport is limited and rail can be a competitive alternative internationally. If, without support, a single wagonload operator in one country ceases to operate, the single wagonload traffic of other countries will be affected and reduced, as that country will be excluded from the network and will no longer be a dispatching or receiving partner.

It is important that the players in the SWL network share their experience and knowledge in order to maintain traffic.