

The Possibility of Transferring the Transport Performance on Railway Transport

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Abstract. The article deals with the transfer of freight from road freight to railway freight transport. In railway transport, individual wagons or groups of wagons with a maximum number of five are used. Combined transport is used for commodity flows. Goods are loaded in ISO 1 containers with an outer length of 20 or 40 feet. Special ramps allow goods to be transported from the ramp to the container and vice versa. The system can be used for storage device, distribution and logistics centres with railway connections to public railway transport.

1. Introduction

The aim of the EU White Paper is to create a so-called "United European Transport Area Plan", which will be created a competitive, resource efficient transport system, namely to move 30% of goods transport over a distance of 300 km from road to other types of transport by 2030. A similar commitment is implemented into the approved Transport Policy of the Czech Republic for the period 2014-2020 with a view to 2050. It is also fully in line with the approved Operational Program Transport for the 2014-2020 period, namely it is a specific objective 1.3 Creating the conditions for greater use of multimodal transport. The main principles set out in the National Emissions Reduction Program will also be implemented, which also concern the transfer of freight transport performance from road to railway freight.

The White Paper - "The way to united European Transport Area, to a Competitive and Effective Transport System" - is a reference document for the creation of a new European transport policy for the period 2012-2020 with a view to 2050, followed by the Trans-European transport network Policy (TEN-T) as the main European instrument for the development of transport infrastructure for long-distance transport flows in order to promote a single European market. The White Paper includes 40 concrete initiatives to build a competitive transport system over the next decade. The main and new objective is to substantially reduce Europe's dependence on imported oil and reduce carbon emissions by 60% by 2050 [2].

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These objectives should be achieved [1, 2]:

- a) By moving 50% of medium- and long-distance freight transport from road to railway and waterborne transport and, in the case of passenger transport, significantly increasing the share of railway transport (including air transport over distances of up to 1000 km, while air transport Long distance flights).
- b) The introduction of alternative transport energies.
- c) The introduction of more efficient engines.
- d) The application of ITS in all modes of transport in order to optimize transport and transport processes (as elaborated in EU ITS Policy).

The "New initiatives by the European Commission to future mobility" were published on the last day of May 2015.

The document highlights that the European transport system is undergoing major changes. Moving towards more integrated and more modal mobility systems, which require a more comprehensive and cross-cutting approach and involve a wide range of transport policy areas at EU level.

The aim of the proclaimed documents is to create viable future road systems and intermodal mobility systems, increase competitiveness, strengthen social justice and enforce zero emissions.

Europe on the move includes:

- A policy statement setting out a long-term plan to deliver clean, socially equitable and competitive mobility for the whole of Europe.
- A set of eight legislative initiatives focusing on road transport. Their aim is to improve road transport, in particular the road haulage market; Improving the working and social conditions of workers (truck drivers) and promoting smart road charging across Europe.
- Several non-legislative measures that represent a wide range of EU policy support measures to accelerate the transition to a sustainable, digital and integrated mobility system (investment finance for infrastructure, research and innovation, cooperation platforms, etc.).

2. Way of solving the issue

Meet the implementation of the above mentioned objectives in the introduction of the contribution is very complex because the road freight transport shows a lower total transport cost per ton than that it is in railway transport. By enhancing the level of cooperation between individual carriers in the supply chain, using combined transport systems, a competitive price for transport services can be achieved.

The solution is based on statistical data [3] that are issued for each mode of transport. For the transport of individual consignments, it is possible to rely on the total data for railway transport. The average share of individual wagon consignments from the total data was 35% in individual years.

For a higher degree of cooperation in transport performance, it is important that storage facilities, distribution and logistics centres are connected to railway transport.

In most European countries, with the exception of Switzerland, discussions are being held on the end of the transport of unprofitable individual wagon loads. These shipments are exclusively carried by national freight carriers.

2.1 Development of goods transport in the Czech Republic by transport modes

For the Czech Republic, land transport modes are crucial, which is similar to the share of total traffic volume or traffic performance as the EU countries (see Tab. 1 and Fig. 1).

Since 2010, there has been a decline in the decrease of goods transport in thousands of tons, and also in transport performance in ton-kilometres (ton-km) [3].

Average share of railway freight transport in total transport in thousands of tons was 18.1% and road freight transport 79.5%.

Average share of railway freight transport in overall transport performance in millions ton-kilometres was 21.03% and road freight transport 7.3%.

Table 1. Interdisciplinary comparisons of transport performance. Source: [3]

	2010	2012	2013	2014	2015	2016
Transport of goods in total (thousands of tons)	451,671	435,449	447,367	491,625	549,085	539,062
Railway transport	82,900	82,968	83,957	91,564	97,280	98,033
Road transport	355,911	339,314	351,517	386,243	438,906	431,889
Inland waterway transport	1,642	1,766	1,618	1,780	1,853	1,779
Air transport	14	9	9	9	6	6
Pipelines	11,205	11,392	10,266	12,029	11,040	7,356
Total transport performance (millions ton-kilometres)	68,495	68,087	71,509	71,421	76,613	68,172
Railway transport	13,770	14,266	13,965	14,574	15,261	15,618
Road transport	51,832	51,228	54,893	54,092	58,714	50,315
Inland waterway transport	679	669	693	656	585	620
Air transport	22	17	24	35	31	31

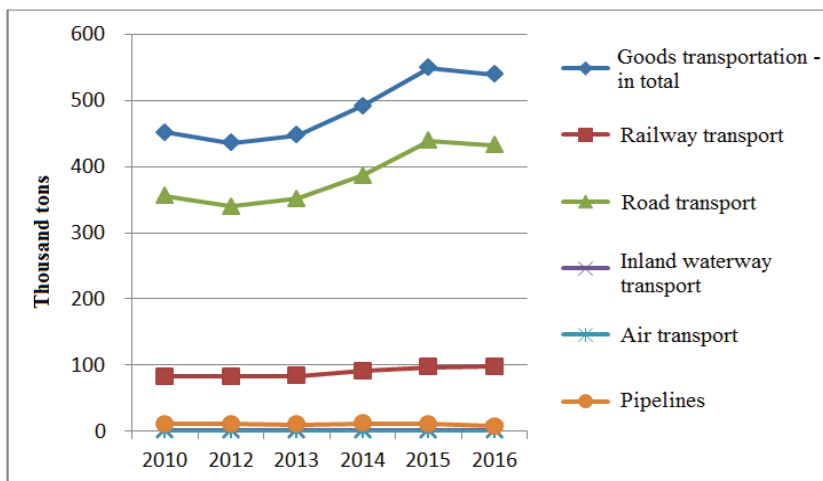


Fig. 1. Graphical representation of transport development in thousands of tons. Source: [3]

2.2 Estimation of individual and group wagon consignments

The carriage of individual and group wagon consignments (maximum of five wagons) reached 34,312 thousand tons in 2016. In the case of greater connection of business entities using railway freight transport, significant savings in CO₂ production and road infrastructure wear would be achieved.

3. Results

The optimal solution for reinforcing individual and group wagon loads in railway transport is the higher degree of use of combined or intermodal transport. The Group of Freight Transports of the Swiss State Railways SBB Cargo has put into operation twenty-foot handling platforms with corner fixing elements that can be placed on a Sgnss railway wagon in a total of 3 platforms. These platforms are manufactured by Invekta, a.s., Vlkov near Litomyšl. The actual weight of one platform is 1.8 t and forms a connection between the railway loading surface of the wagon and the loaded container. Placing the platforms on a railway wagon creates a trolley handling surface that allows devices to handle along the ramp, railcar and container in the logistics chain. The “ramp-ramp” delivery system of goods is created [4, 5].

The platforms can be easily loaded and secured by means of corner fixing elements on a railway carriage, or can be removed and folded into a deck in the combined transport terminal. An example of handling is shown in figure 2 [6].

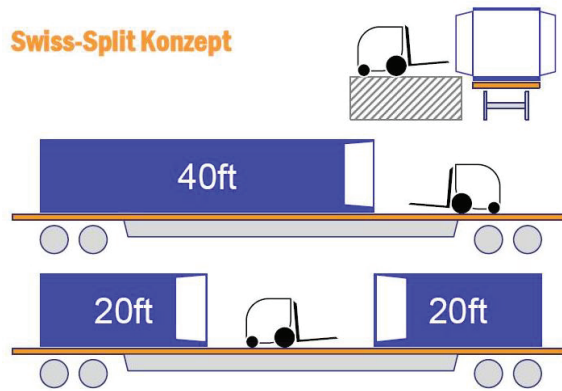


Fig. 2. An example of the use of handling platforms. Source: [6]

4. Discussion

In the case of the completion of the shipment of individual consignments according to the data from 2016, the transfer to the road freight transport would take place. Basic cost calculations can calculate the economic costs of road wear [7].

The semitrailer wears the road communication (infrastructure) about 15.824 CZK per 1 km [8]. The average transport distance by railways for individual consignments is 159 km. The transport volume in tons in 2016 was for individual consignments 34,312 tons.

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Such an amount would take them approximately 1.72 million of road articulated vehicles according to the relation (equation 1) [9, 10]:

$$N = \frac{Q_{tr}}{N_{loading\ capacity}} \text{ [pcs]} \tag{1}$$

where: N – number of articulated vehicles [pcs]; Q_{tr} – the volume of carriage by individual wagon consignments [pcs.ton]; $N_{loading\ capacity}$ – loading capacity (payload) of the semi-trailer [t].

$$N = \frac{34.312\text{mil.pcs}}{20\ \text{t}} = 1.72\ \text{mil. art. veh.}$$

Considering that, road semi-trailer kits (articulated vehicles) will be used for both directions at 80%, the annual mileage is about 330.24 million km.

To calculate the road infrastructure wear, we use the relation (equation 2) [9-11]:

$$P_{wear} = L_{year} * P_{wear\ art.veh.} \text{ [CZK]} \quad (2)$$

where: P_{wear} – road infrastructure wear [CZK]; L_{year} – annual traveled km of articulated vehicles [mil. km]; $P_{wear\ art.veh.}$ – road infrastructure wear by the articulated vehicle [CZK/km].

$$P_{wear} = 330.24\ mil.\ km * 16\ CZK/km = 5.284\ mld.\ CZK$$

Calculation of CO₂ production according to equations (3) and (4) in the case that performances of individual consignments are transferred to road freight transport. Is as follows [9, 12]:

$$Q_{CO_2} = L_{year} * \emptyset C_D \text{ [l]} \quad (3)$$

where: Q_{CO_2} – total diesel fuel consumption [l]; L_{year} – annual traveled km of articulated vehicles [mil. km]; $\emptyset C_D$ – estimated average diesel fuel consumption [l/km].

$$Q_{CO_2} = 330.24\ mil.\ km * 0.35\ \frac{l}{km} = 115.6\ mil.\ l$$

$$TP_{CO_2} = C_D * Q_{CO_2} \text{ [t]} \quad (4)$$

where: TP_{CO_2} – total production of CO₂ [t]; C_D – total diesel fuel consumption [l]; Q_{CO_2} – the amount of CO₂ when burning 1 liter of diesel fuel [t] = 2.64 kg CO₂.

$$CP_{CO_2} = 115.6\ mil.\ l * 0.00264 = 305.184\ t$$

The abovementioned values of road infrastructure wear and calculation of total CO₂ production are only some of the negative impacts of the modal shift of the system of single and group wagon loads on road freight transport. It should also be noted that there is a disproportion between the existing toll system, which is valid only on certain designated networks of roads in the Czech Republic, and the fee for the use of the railway route for railway transport, where the whole railway network of the is charged. High accident rate of road transport is another negative factor in goods transportation on the road [13-17].

5. Conclusion

Intermodal transport represents the transportation of cargo by several transport modes using one and the same intermodal transport unit without handling with its contents during transportation.

The development of transport in the world is characterized by the utmost effort to increase the speed, reliability and accuracy of goods delivery in freight transport using modern technical equipment and information technologies. In Europe, intermodal transport is an indispensable element of transport policy, especially due to reducing the negative effects of road transport on the environment, fuel and energy consumption, maintenance costs on highways and roads, land consumption and road safety.

The paper discusses the possibility of transferring freight transport to railway transport using combined or intermodal transport. For railway transport, it is a complex problem to deliver goods to the final customer's yard, so-called "last mile". This system effectively addresses this problem.

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