Costs Comparison and the Possibilities of Increasing the Transport Capacity with a Selection of the Appropriate Railway Wagons

Usporedbe troškova i mogućnosti povećanja prijevoznih kapaciteta selekcijom prikladnih željezničkih vagona

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DOI 10.17818/NM/2016/SI3
UDK 656.22
656.23
Preliminary communication / *Prethodno priopćenje*
Paper accepted / *Rukopis primljen:* 21. 3. 2016.

Summary

The paper is focused on the possibilities of increasing the transport capacity of the selected train (train number 51712) with more appropriate selection of wagons and cost analysis using the wagons, irrespective of their advantage, and after application of the new proposal. The transport capacity of the selected train was characterized through the transport indicators - the technical coefficient of tare and the ratio of the maximum loading weight to tare of railway wagon.

KEY WORDS

capacity, calculation, costs train, commodity, wagon comparison

Sažetak

Članak je usredotočen na mogućnosti povećanja prijevoznog kapaciteta odabranog vlaka (vlak broj 51712) s prikladnijim odabirom vagona i analizom troška koristeći vagone, bez obzira na njihove prednosti i nakon primjene novog prijedloga. Kapacitet prijevoza odabranog vlaka je karakteriziran putem transportnih pokazatelja-tehnički koeficijent tare i omjer maksimalno ukrcane težine u odnosu na taru željezničkog vagona.

KLJUČNE RIJEČI

kapacitet, izračun, troškovi, vlak, roba, vagon usporedba

1. INTRODUCTION

The selection of the appropriate means of transport is a crucial factor to ensure the quality transport services and reducing the costs of train. The carrier can provide quality transportation services, can be flexible, reliable, have adequate prices, but the resulting quality of the transfer of goods from the place of departure to final destination will always depend on the appropriate choice of means of transport - railway wagon what also can have the effect of reducing the final price for the customer.

2 PROPOSAL OF INCREASING THE TRANSPORT CAPACITY

The transport capacity of a train can be characterized by several indicators, for example [1]:

- gross train weight,
- number of transported railway wagons,
- number of intermodal transport units,
- net train weight.

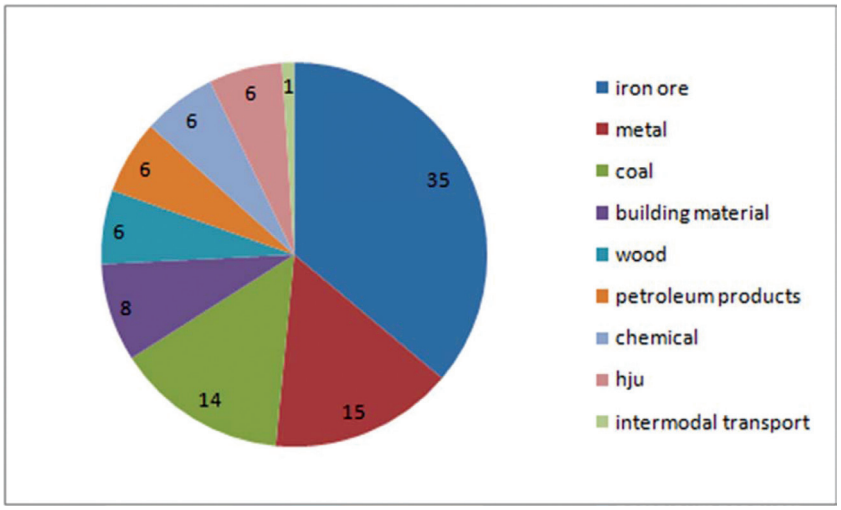
This proposal will focus on the net train weight - the weight of the goods transported in one train. We focus on the possibility of increasing the net weight of a train by a suitable choice of the railway wagons [1-3].

The base is made up of real train according to the transformation plan. We will compare the original composition of this train with the new composition realized with a selection of the most appropriate railway wagons. After that, it will be made an assessment what amount of goods can be transported in one train, therefore, how much will increase the transport capacity of this train. The choice of commodities is executed on the basis of statistic most transported commodities by ZSSK Cargo for the year 2013. The share of individual commodities transported by ZSSK Cargo is shown in figure 1 [7, 9].

The largest share of transport had iron ore, and up to 35%. Other major commodities were metals and coal and the share of 6% had wood, petroleum products, chemicals, intermodal transport. The commodity groceries represented only 1% [7].

3. INTRODUCTION OF THE PROPOSAL ON THE TRAIN 51712

An important step in optimization of transport capacity is the comparison between the use of original railway wagons in the analyzed train and alternative composition of train with the proposed type of freight wagons. The analyzed train number 51712 has the sending station in Čierna nad Tisou and the final



Source: Annual report 2013 of ZSSK Cargo a.s

Figure 1 The share of transported commodities in 2013

station is Bratislava-Pálenisko. All information about the train, for example normative of weight, normative of length, transport distance and others, are shown in table 1.

The normative of weight of analyzed train is 2 400 tons, however, there are several sections with lower normative where is needed to use an additional locomotive and also is necessary to change the type of the locomotive 131 for the locomotive 363 because of the different traction system [3], [4].

Table 1 Information about the train 51712

Train number	Pn 51712
Normative of weight [t]	2400
Normative of lenght [m]	550
Type of locomotive	131/363
Sending station	Čierna nad Tisou
Final station	Bratislava Pálenisko
Transport time [h]	12.75
Transport distance [km]	543

Source: authors

The following table (Table 2) compares the composition of the train 51712 before and after implementing our proposal. It contains information such as the gross train weight, the weight of empty wagons and the net train weight [3-5].

In the composition of the train 51712 from appropriate railway wagons Eamos 5941, it is visible difference in comparison with original train without the selection and the use this type of railway wagons. This difference represents about 98.3 tons of transported goods more and also decreases the weight of wagons a total of 85 tons [5, 7, 8].

4. EVALUATION OF PROPOSED CHANGE IN THE COMPOSITION OF THE ANALYZED TRAIN

After application of the proposal, we can evaluate the effectiveness of this proposal in terms of increasing the transport capacity. Increasing the transport capacity of one train can generally contribute to optimize the transport capacity of the enterprise [2], [6].

Table 3 shows the effects of the preferred choice of the wagon to change the transport capacity of one train. For better explanatory power of these data, we decided to take

Table 2 Composition of wagons in the train 51712 without measures and after the introduction of the proposal

Composition of wagons in the train without measures					
Type of wagon	Number of wagons	Weight of wagons [t]	weight of goods in one wagon [t]	weight of goods – together [t]	Transported commodity
Eanos 5376	11	273.9	57.6	633.6	iron ore
Eaos 5301,5330	5	107.5	58.5	292.5	iron ore
Eas 5970-5979	7	161	57	399	iron ore
Eanos 5377	6	146.4	57.6	345.6	iron ore
Σ	29	688.8		1670.7	
Weight of train [t]	2359.5				
Composition of wagons in the train after the introduction of the proposal					
Type of wagon	Number of wagons	Weight of wagons [t]	weight of goods in one wagon [t]	weight of goods – together [t]	Transported commodity
Eamos 5941	29	603.2	61	1769	iron ore
Σ	29	603.2		1769	
Weight of train [t]	2372.2				

Source: authors

Table 3 The evaluation of the transport capacity after the introduction of the proposal

Train number	Net train weight		Increase of transport capacity (1 train) [t]	Increase of transport capacity (20 trains) [t]
	Without measures [t]	After the introduction of the proposal [t]		
51712	1670.7	1769	98.3	1966

Source: authors

Table 4 the change in the number of needed trains after the introduction of the proposal

Train number	Volume of transport [t]	Number of trains before the introduction of the proposal	Number of trains after the introduction of the proposal
51712	33414	20	19

Source: authors

into account the increase in the net weight of analyzed train in case of more trains. According to the results obtained after the implementation of the proposal, it is the possibility to transport the same quantity of goods in fewer trains. The transport capacity of the train after implementing the proposed measures has increased by a total of 98.3 tons, and in comparison with 20 trains assembled with the same wagons the increase represents of up to 1966 tons.

This value is higher than the transport capacity of a train before implementing the proposal, which is ultimately reflected in the reduction of the required number of trains [3].

In the original variant, there were 33 414 tons of goods transported by 20 trains and after implementing the proposal is ZSSK Cargo able to transport this amount by 19 trains [3].

According to the realized calculations, we can set a limit of the quantity of goods, when the number of trains needed to transport the same amount of goods reduces. This limit is specified in Table 4 [8].

The problem may occur in the lease of wagons needed to composition of the train. The contracting company AAE, which provides the service of renting wagons for company ZSSK Cargo, not always must have the requisite number of needed empty wagons. In that case, the use of wagons from another company can cause a higher price of the lease than from the contracting company AAE [2], [7].

5. COSTS CALCULATION FOR SELECTED TRAIN

The costs of the train 51712 are calculated according to information from the transformation plan for the 2014/2015, from the timetable and from the document about the determination of charges for access to railway infrastructure valid from 2. December 2010 and also another valid from 24 may 2012 no. 7/2012, which amends the previous one. This paper also presents the methodology for calculating the costs of access to the railway infrastructure and fees associated with its use. It is necessary to know the exact cost rate for correct calculation [2, 4, 11]:

- hourly rate for locomotive crew
- rate of locomotive kilometer

Important data are the specific energy consumption of locomotive, which is different for diesel-electric traction and electric traction (dc or ac traction), and also price for electricity consumption.

The following section examines the costs of the train before and after the realizing of the proposal. All information about the train 51712 needed to the calculation are shown in table 5 [1-4], [8].

Table 5 Basic parameters for costs calculating

Basic parameters	Train 51712	
	without measures	after the introduction of the proposal
Type of locomotive	131/363	131/363
Weight of locomotive [t]	169.2/87	169.2/87
Sending station	Čierna nad Tisou	
Final station	Bratislava Pálenisko	
Transport distance (the railway lines of the first category) [km]	543	543
Train speed [km/h]	90	90
Transport time [h]	12.75	12.75
Gross train weight [t]	2359.5	2372.2
Gross train weight + locomotive [t]	2529/2447	2542/2460
Net train weight [t]	1670.7	1769
Number of stations A category	2	2
Number of stations B category	1	1
Number of stations C category	0	0
Number of stations D category	0	0
Rent of railway wagon in 24 hours [€]	10.35	10.35
Number of wagons in the train	29	29
Transport time with additional locomotive [h]	2.75	2.75

Source: authors

Table 6 Costs analysis of the train 51712

Indicator	Train 51712	
	without measures	after the introduction of the proposal
Auxiliary indicators		
hourly rate for locomotive crew	13.55	13.55
rate of locomotive kilometer	1.1	1.1
∑ net ton kilometers	907190.1	960567
∑ wagon kilometers	15747	15747
∑ gross tonnage kilometers of the load	1281208.5	1288104.6
∑ train kilometers	543	543
Weight of train [t]	2359.5	2372.2
∑ locomotive kilometers	422.9 / 258.5	422.9 / 258.5
∑ locomotive gross tonnage kilometers	71560.6 / 22492.1	71560.6 / 22492.1
∑ train crew employee hours	16,5	16.5
Costs of rail infrastructure		
costs for ordering and allocation of capacity	11.24 €	11.24 €
costs for the management and organization of traffic	520.19 €	520.19 €
costs for operation of the railway network	1 117.33 €	1 117.33 €
	683.00 €	683.00 €
costs for access to marshalling yards	221.59 €	221.59 €
	135.45 €	135.45 €
costs for access to the traction system	136.98 €	136.98 €
∑	2 825.79 €	2 825.79 €
Costs of wagons		
C_w	159.45 €	159.45 €
Costs of locomotives		
C_l	284.38 €	284.38 €
Costs of locomotive crew		
C_{lc}	223.58 €	223.58 €
Costs of energy		
C_e	3 127.85 €	3 144.39 €
Costs of commercial operations		
C_{co}	85.50 €	85.50 €
Total costs		
C_{direct}	6 706.54 €	6 723.09 €
$C_{indirect}$	2 235.51 €	2 241.03 €
C_{total}	8 942.06 €	8 964.12 €

Source: authors

Table 7 Comparison of profit before and after the introduction of the proposal

Train number	Freightage [€]		Costs of operating the train [€]		Profit before tax [€]		Increase in profit before tax [€]
	Without measures	After the introduction of the proposal	Without measures	After the introduction of the proposal	Without measures	After the introduction of the proposal	
51712	73677.9	78012.9	8942.06	8964.12	64735.8	69048.8	4312.97

Source: authors

The accurate cost analysis of the train 51712 is expressed in the following table 6 [2], [6]:

The visible increase in costs after the implementing of the proposal about 22.06 € can be considered to be negligible in comparison with the increase of transport capacity a total of 98.3 tons in the one train.

6. TECHNICAL - ECONOMIC EVALUATION OF OPTIMIZING THE TRANSPORT CAPACITY

The final part of the paper is dedicated to the calculation of the profit from the analyzed train 51712 (before and after the introduction of the proposal) before tax. Profit before tax is the difference between the freightage, which is calculated according to the current tariff conditions specified in the tariff of ZSSK Cargo (tr1) and the costs of one train. The prices are just as offer and the actual price may be at a different level and is dependent on the type of transport, type of commodity, regularity and agreement between the customer and the carrier. Information on special price conditions are a trade secret, so the gain is calculated from available tariff conditions of the carrier.

The choice of the appropriate railway wagons has an influence not only on increasing the transport capacity of

one train but also on increasing the profit from this train. The difference between profit from the train with the original composition and profit from the train with proposed composition is shown in table 7 [10].

Increase of profit is due to the higher transport capacity by a total of 98.3 tons. The introduction of the proposal has a positive influence for the carrier - mainly the increase of profit from one train, but also the lower number of trains required for transportation of certain amount of goods [12].

7. CONCLUSION

Optimizing the transport capacity was carried out with regard to the possibility of increasing the transport capacity of the one train. The necessary step was to lay down appropriate criterion to achieve an increase of the transport capacity.

The main criterion was the selection of appropriate wagons according to the transport characteristics of types of railway wagons.

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