Research Paper Engineering

Optimum Financial Allocations on Repair and Maintenance of Railways According to Their Current Technical Status

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ABSTRACT

Transport Research Centre, v.v.i. has completed the research and development project within the research program of the Ministry of Transport, dealing with research on the optimum allocation of funds for repair and maintenance of the railway infrastructure taking into account its current technical status.
In addition to extensive and detailed analytical work a significant part of the solution was a calculation that demonstrates how available outputs of the railway economy information system can be currently used for that purpose (with minimal additional financial cost).
There is a current interest of the project outputs by the State Fund for Transport Infrastructure and Railway Infrastructure Administration.

KEYWORDS railway track, repair and maintenance, funding allocation.

1 INTRODUCTION

Transport Research Centre, v.v.i. has realized a research and development project within the research program of the Ministry of Transport, dealing with research on the optimum allocation of funds for the repair and maintenance of the railway infrastructure, taking into account its current technical status.

In addition to extensive and detailed analytical work a significant part of the solution was a calculation demonstrating how available outputs of the currently used track management system can be used for the above mentioned purpose with minimum additional financial cost.

Phases of the research project:

- current state of research in the allocation of funds for maintenance and repair of railway infrastructure on national and international levels,
- determining the availability of the input data from the Information System Track Management (ISTM) for further calculations,
- calculate the recalculated length of tracks.

2 Current state of research in the allocation of funds for maintenance and repair of railway infrastructure on national and international levels

The input data used for planning needs of working hours, men labour and material for repair work on the railway track and substructure, bridge and tunnel buildings, railway buildings and partly on communication and signalling equipment and electrical equipment are so called maintenance units (MU), supplemented by technical units (TU) for control, signalling and electrical equipment.

Current methodology for calculating MU of railway track and substructure has significant drawbacks. The cost of running track are determined by means of “objectification” of the track using correction factors that were selected, assessed in scale and quantified in the past on the basis of “qualified estimate.”

Current methodologydoes not take into account the technical condition of the track and the lack of any connection to the diagnostic system; influence of railway operations is expressed only with operating load factors, regardless its structure.

Methodology for calculating the MU of other entities has similar shortcomings as it takes into account only some of the technical elements of an entity. Calculation of the maintenance of communication, signallingand electrical equipment is performed as a more sophisticated summary of technical (TU) and maintenance units (MU). However, MU is not expressed by linear (or volume) unit, but directly indicates the time required for maintenance of a specific device in hours per year. Subsequently derived TU forms the basis for determining the number of employees to maintain the operability of the device, i.e. it determines the number of MU, which corresponds to the annual fund net working hours per employee.

The cost of the modernization and development of the railway infrastructure are financed from the state budget through the State Fund for Transport Infrastructure (SFTI), also partly the operational cost of the railway infrastructure is carried out in accordance with the present contract between SFTI and the Railway Infrastructure Administration (RIA). Additional funding represents its own budget of RIA, in particular, income from sales (fees for the use of railway infrastructure), income from the sale of assets, loans and financial resources from European funds.

For secondary distribution of funds RIA uses the originally taken and a commission approved algorithm, which dates back to the period before the transformation of Czech Railways (CR), state organization and subsequent conversion of RIA from CR, joint stock company to RIA, state organization. The key is constituted of these decisive criteria for the allocation of finance:

- amount of the assets of the RIA, determined by the total number of maintenance units (MU) of railway infrastructure individual entities,
- working load of the tracks specified in train-kilometres, respectively in gtkm.

Weight of the criteria specified in this case was identical and were considered of equal importance. The allocation of funds disregarded the current technical condition of the railway infrastructure.

Currently for the allocation of available financial resources to various RIA a simplified allocation methodology is applied, which is based on a comparative statistical calculation, which numerically evaluates the expected development of the technical condition of the railway infrastructure, depending on the amount of funds allocated in the previous period. Important benefits of the calculation are the current technical condition of the individual entities of the railway infrastructurethat are taken into account. It is based on an average cost without taking into account any marginal financing of railway infrastructure.

There was found no evidence that would imply the existence of higher-order systems to determine automatically the amount of funds that should be inserted into the rail services based on the technical condition of the railway infrastructure and railway vehicle. The output data even though having assigned priority criteria within individual systems, are used only as a reference according to the information obtained (albeit serious and relatively objective) for decision making of stakeholders.

Based on the outputs of this phase of the project we came to the conclusion that an economic instrument of higher order system for optimal allocation of funds for railway infrastructure, which takes into account the wear and degradation processes of individual entities is of paramount importancein the Czech Republic.

3 The calculation of recalculated length of tracks

The calculation of recalculated length of tracks was made on the basis of the data gained from ISTM that was updated for this purpose. The calculation itself used computational coefficients assessing current technical status of entities of the railway track.

3.1 Railway track maintenance coefficient

There are expressed all the basic quantitative and qualitative indicators examining the track - the track section. These include:

- number of major tracks and others,
- operational track loading,
- line speed,
- direction, tilt and geology relations,
- age and the incidence of other objects (points, crossings, platforms, continuous welded rail and others).

To express the intensity of maintenance service, existing maintenance units of RIA were used. As a basis (coefficient = 1.00) a network-wide weighted average was used.

3.2Current status of the track coefficient

This factor is derived from the overall quality label of tracks (QLT). QLT ranges within the values 0.00   5.00. Tracks classified with the value of QLT 0.00   4.00 are the tracks which basically correspond to the technical quality requirements (though to varying degrees). Track which is QLT > 4.00 is unsatisfactory as it does not match the operating parameters-deviations of qualitative indicators of the track geometrical parameters for the routes according to the norm CSN 73 6360.

3.3Electric equipment coefficient

Within the selected standard sections a detailed analysis of maintenance units needs was performed, which resulted in the determination of specific maintenance units per kilometer route selected (reference) types of tracks.

These specific maintenance units were assigned to the different types of tracks and traction code, and coefficient of performance of the maintenance of electrical equipment was calculated, as an equivalent of whole network average.

3.4 Communication and signalling equipment Kzz

The coefficient is based also on a detailed analysis of the needs of maintenance units in the communication and signalling systems.

Cost of each track type was expressed with measuring maintenance units (per kilometre track) including the effect of material costs, which is different with prevailing types of signalling equipment.

3.5 Infrastructure cost classification

The percentage of the costs of the various entities of the railway infrastructure is also expressed by a coefficient. In this context it should be emphasized that the costs incurred currently do not express a real need, but only the distribution of the financial amount available to each of the rail infrastructures.

3.6 Results

In tables 1 and 2 is a mutual comparison of maintenance intensity for all SDC according to recalculated length and according to the percentage of length of single categories of tracks.

TABLE 1 Recalculated lengths of tracks in km

RIA	National railway tracks					regional	Monitored tracks in total
	K1- Modernized corridor	K2- non modernised corridor	H - main	O - other	Total	R	
Ústí n/L	2.77		3.32	3.28	9.37	2.14	11.51
Karlovy Vary		0.54	1.18	1.06	2.78	1.36	4.14
Plzeň		2.11	0.74	2.29	5.14	1.60	6.74
České Budějovice		2.11	1.48	1.51	5.10	2.83	7.93
Praha	2.32	3.50	3.08	4.79	13.69	3.55	17.24
Liberec				2.99	2.99	1.66	4.65
Hradec Králové			1.39	3.52	4.91	1.40	6.31
Pardubice	3.53	0.70	0.30	1.67	6.20	1.44	7.64
Jihlava			3.53	1.40	4.93	1.69	6.62
Brno	3.83		1.81	2.30	7.94	1.22	9.16
Olomouc	1.13	2.19	1.18	1.91	6.41	0.72	7.13
Ostrava	2.60	1.05	0.43	1.82	5.90	1.56	7.46
Zlín	1.36		0.50	1.08	2.94	0.53	3.47
Total [%]	17.54	12.20	18.94	29.62	78.30	21.70	100.00

Source: Authors

TABLE – 2 Percentage of cost requirements according to recalculated length of tracks

RIA	National railway tracks					regional	Monitored tracks in total
	K1- Modernized corridor	K2- non modernised corridor	H - main	O - other	Total	R	
Ústí n/L	399.63		479.19	473.38	1,352.20	310.03	1,662.23
Karlovy Vary		77.21	170.84	152.97	401.02	196.87	597.89
Plzeň		304.41	106.31	331.52	742.24	231.64	973.88
České Budějovice		304.52	213.78	219.08	737.38	409.09	1,146.47
Praha	336.00	505.43	445.56	691.70	1,978.69	513.87	2,492.56
Liberec				431.51	431.51	240.34	671.85
Hradec Králové			200.60	508.90	709.50	203.09	912.59
Pardubice	509.94	101.33	43.05	240.64	894.96	207.46	1,102.42
Jihlava			511.07	202.73	713.80	244.39	958.19
Brno	554.12		261.50	332.64	1,148.26	176.46	1,324.72
Olomouc	163.43	316.30	171.40	276.29	927.42	104.17	1,031.59
Ostrava	376.05	150.90	62.08	263.33	852.36	225.73	1,078.09
Zlín	196.53		72.04	156.73	425.30	76.64	501.94
Total [km]	2,535.70	1,760.10	2,737.42	4,281.42	11,314.64	3,139.78	14,454.42

Source: Authors

4 Conclusions

The outputs of the project have clearly documented the practical use of the proposed system for the allocation of funds for the repair and maintenance of the railway infrastructure taking into account its current technical status and using the output of diagnostics RIA.

As part of the pilot testing of the system the calculation was performed for the entire rail network in the administration of RIA, which documents the modesty of calculation that can be done in EXCEL software. Implementation of partial calculation only for individual RIA can be made in a more elementary way.

Percentage of converted km of tracks can be used at any level of management when dividing the amount available of non-capital funding from different sources to different regions or categories of tracks. The same algorithm can also be used retrospectively to determine the total cost, if specific value of necessary costs in some categories of tracks is available.

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REFERENCES

[1] Hrebicek, Z. (2010). "Research on optimum allocation of funds for repair and maintenance of railway tracks regarding the current technical status": Final report to E04. Ministry of Transport of the Czech Republic. Brno: Transport research centre, v.v.i.