TECHNIKA TRANSPORTU SZYNOWEGO

Martin HALÁS, Vladislav ZITRICKÝ, Peter BLAHO

SEVERAL PROPOSALS FOR INCREASE OF RAILWAY TRANSPORT EFFECTIVENESS

Abstract

The most of the investments to a railway infrastructure in in various countries are consumed by modernization of railway lines, that is necessary because of their integration as a part of Trans-European Railway Network (TEN-T). The rest of railway network seems to be overlooked due to its less importance for the international relationships in railway transport. The regional lines offers a mobility, for which is very important to maintenance and improving of the railway infrastructure.

This paper extends a general overlook on a draft for a modernization of regional lines to ensure required quality in railway transportation and as example of a case study the proposals are applicated at the regional line of Railways of Slovak Republic (ŽSR - Slovak Railway Infrastructure Manager).

INTRODUCTION

Under the transformation and liberalization of the railway market, the new separated subjects inherently needs to cooperate so they are able to proceed as the one entity. Thus formed philosophy, that can after transforming to reality can bring a new cooperation across the railway sector regardless of competetiveness inside railway sector between the subjects in railway market. There is no more competitiveness as a the main priority but cooperation seems to bring higher prosperity.

There are various ways to make the railway sector more attractive - economical measures (price and tariff policy, minimalization of costs) or traffic-organizational measures (optimalization of shifts, turnover of vehicles, harmonization of timetables). These measurements should be done under the coordination between subjects of railway market – at all between infrastructure manager (IM) and railway undertakings (RU). Stimulating the development of regional rail transport requires impulses mainly from the IM, in particular structural modifications of tracks and billing of infrastructure for regional transport.

1. GENERAL DESCRIPTION OF EFFECTIVENESS PROPOSALS

According to the categorization [3] we define this measurements:

- *Operational-organizational measures*, which mean improving of technological and organizational steps, elimination of its quantity and reduction of time demand. As an advantage is its very short time of realization and very low costs. But there is no positive result without the synergy of other implemented measures,
- *build-constructional measures*, which mean the changes in technical and constructional layout of stations and track sections and its accessories (horizontal and vertical

adjustment of a rail, construction of underpasses, platforms, new interlocking and communication systems and so on. The negative site is high costingness and time consuming for realization past normal traffic operation,

- *inovation measures (of IT systems and interlockings),* which allow to collect, exchange, classificate and change information more effective and easier for more security in traffic operation. The measure is high-cost as well, but the investments consumed by its realization are continuously returned by saving of operating costs.

Each of the measurement represents an individual group of difficulty for investment consuming, realization time and technical solution. It is possible to apply them generally to any of railway tracks in any combination, but some modifications are still necessary. It is based on a need to be set and realized in a right sequence, so required effect can be brought.

Under these measurements it is appropriate to propose a set of specific elements of rationalization, which are directly related to the regional lines and whose implementation the desired effect is achieved. It should be noted that the only right and appropriately chosen mix of implemented measurements is the way how it´s possible to achieve the best synergy.

2. THE PROPOSAL OF A SEVERAL MEASURES

✓ *Rationalization of locomotive recoupling duration*

This operational measurement does not require any investment and it can save train running times easily. It´s mainly about the removal of conflicting or simultaneous actions, that reduce the effectiveness of locomotive recoupling technology. Thus, if the locomotive is uncoupled by IM´s employee or by another operator´s employee and according to the regulation is the locomotive driver obligatory to uncouple the electric cable, there is need to organize all this action by operator´s staff. This measurement saves the costs to the operator (RU). In some cases could it lead to the longer duration of this operations but there is a better organization of this operations possible. The next step requires to harmonize an activities of IM, who controlls the railway traffic in a station. That means the most effective use of all persons participated in this process to achieve a reduction of stoppage and dwell time.

Fig. 1. Example of a Push-Pull set – ZSSK 381/051/051/951

(**source:** authors)

It can also be very effective to use in the railway traffic a new modern trains, especially progressive sets like multiple units and its parallel called “Push-Pull” upgraded from conventional sets which consist of passenger coaches, locomotive and special ending coach that is able to control locomotive on the other side of own set. It means, there is no more need to change locomotive position from the beginning of train to the end and back during the train turnover.

✓ *Rationalization of a timetable construction*

This measurement tells about analyzing of a points of railway infrastructure (usually stations) in which is possible to optimize the crossing of trains and revaluate the stopping nad dwell time of regional trains. There are the problematic stations equipped by old interlockings. In case study there was supposed cancelling of stoppage of the regional trains at stops, that are several hundred meters away from populated areas and it is more effective to carry passengers by bus.

✓ *Light modernization of track sections - exploring the current potential*

The solution of this measure lies in finding out the upper track speed limit according to the constructed parameters (the horizontal direction of the track and other limiting factors) and to the cost effectiveness. In the case study was supposed the adaptation the track slope and superelevation. The deficiency of track cant doesn´t allow the possible speed. If the curve radius and the horizontal and vertical transition of track is convenient, so that is need to increase speed limit by an adaptation of the gravel ballast and adjustment of signaling equipment and other components of interlocking devices.

The problem in the study line Nitra – Leopoldov is particularly the stations that have unsecured switches and low secured interlocking and in which is the top speed limit only to 40 $km.h^{-1}$, but both of adjacent track sections have generally the maximum speed limit (mostly 100 $km.h^{-1}$), so theses stations create a bottlenecks in reaching constant track speed. The measure requires to spend some investments for implementation a new modern interlocking, that means to implement switch-lock systems for higher speed and replece an old mechanical signaling system (semaphores) by a new illuminating signals, that are depended on switch position and other signals (routing) and are also able to signal the speed limit in a switches district and so on. There are several ways how this measure can be realized. But an implementation of the newest interlocking systems seems to be the most effective way by considering the future.

✓ *Partial increase of track speed limit*

This measure begins with a set of construction modifications of a wider scale, especially in terms of horizontal direction of the track. These measures imply the need for spending large amounts of investments, they are more demanding on time and they also largely affect the current traffic operation. Implementation is preceeded by an exhaustive analysis of track body, its estate and direction or an altitude conditions. It is possible to allocate the track sections that can be subjected to this rationalization measure right by this analysis.

Fig. 2. Partial increase of track speed – minimal shift

(**source:** authors)

By implementing this measure are modified curves, which radius is convenient for the increased track speed, but there are inconvenient horizontal and vertical transitions that are rated at the current speed limits. Therefore, adapting them to the higher speed comes with a shift of curve position by modification of superelevation runoff and its direction (especially

circular section, because of a tangent runout between non-superelevated straight direction and fully superelevated curve) towards the circular center by a few tens of centimeters, which is depending on the input parameters of the curve (see Fig. 2). This shift should not represent an interference into the railway, but it´s only modification of the upper railway body (gravel ballast) under the shift of the rail in a curve or just a reinforcement of railway bottom, which will not involve a laying of the railway superstructure (grid track and ballast).

✓ *Complete increase of track speed*

This reconstruction measure solves the problem of insufficient track speed profile by complete reconstruction of a basic track body (extent of construction work and economic effects allowance). There is need to reflect general effect. In the case study was suggested the speed profile RP3 (speed zone) with its maximum upper limit of 120 $km.h^{-1.}$ The time savage for speed profile of 140 $km.h^{-1}$ (RP4) is just 2 minutes on 36 km track length.

It is necessary to realize this complete increasing of track speed and to carry out many of the procedures and interferences in the railway infrastructure, which require extensive pre-project and project preparation, respectively its documentation and of course the huge investment costs, which are often increased by the cost of preparation, removal, elimination of secondary effects during the implementation of measure or the actual costs incurred by the limited conditions for the implementation of reconstruction during daily transport traffic [6].

Fig. 3. Complete increase of track speed – new direction

(**source:** authors)

✓ *Establishing of a new stops*

To increase the efficiency of railway transport as well as competitiveness with other transport modes in passenger transport it is needed to revalue the number and situating of the railway points (train stops). This problem should be solved by building of a new railway transport points, so to shorten the walking distance up to 1 km. There is need the cooperation with the municipalities. [2]

The new vehicles can reduce the running time despity more stops due its better traction charactersitcs. In case study is supposed a new train stop in Leopoldov (Leopoldov mesto z.) closer to the build-up area between own station (ŽST Leopoldov) and the train stop at the edge of populated area (Leopoldov zastávka z.) (see Fig. 4).

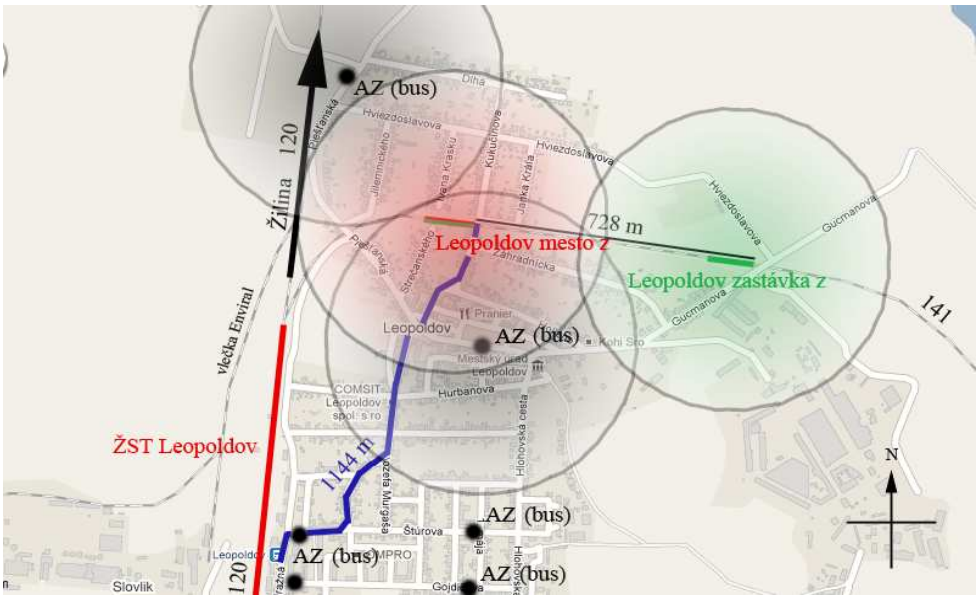

Fig. 4. New stops for better railway range

(**source:** authors)

✓ *Modernization of railway stations*

By implementation of this proposal should be all stations equipped with „island“ platforms (center platforms) and underpasses (see Fig. 5 and 6 – plan for station Nitra).

The second effect should be as an increasing of speed limit in the station. Reconstruction of a station gridiron (development or district of switches) requires investments due to increasing track speed. However, the result will be sharp by powerful station of transport parameters which will be much more safety and effective. Implementation of such measures has a complex character and must involve the other related rationalization measures (comprehensive pre-installation of centrall remote traffic controlling system and so on), which usually also requires similar interferences into the railway infrastructure.

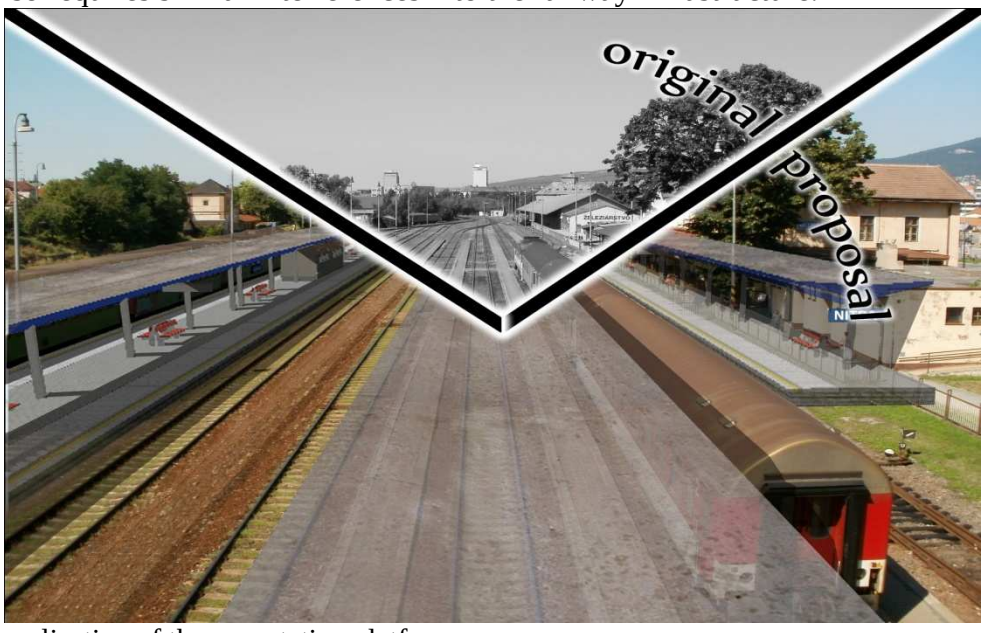

Fig. 5. Visualization of the new station platforms

(**source:** authors)

It is a very important to make a railway transport quick, safety and reliable. To make an underpasses and center platforms is one of the best way how to bring these features in a passenger transport into reality (see Fig. 6).

Fig. 6. Visualization of the new station underpass

(**source:** authors)

✓ *Implementation of remote control center of a line traffic operation*

One of the final extensions in the realization sequence of rationalization measures and also the possibility of its separate implementation is the remote controlled track operation from one control center. This will reduce the number of traffic control personnel (IM) and it is more effective by increasing the capacity of track line even if the controlling is more powerfull by using the common wall-based panoramatic display.

✓ *Electrification of track sections*

This measure is the latest one in a series of implementation proposals. However, this doesn´t exclude the need for electrification of railway tracks, it only moves this need in a chart of urgency to a lower position. Along with the implementation of this measure and its preparing, it´s really necessary to have regard for the possibility of double-tracking the line in the future (location of gantries and pylons for overhead wires), because of the frivolous electrification can bring additional unnecessary costs in the future at an already expensive measure.

CONCLUSION

The investment consumption for the infrastructure, like modernization, optimization, innovation and so on is certainly an important issue for any of the railway infrastructure managers. The implementation of capital-intensive projects are concentrated in the priority projects for modernization of main railway corridors. However, the possibility of the hidden potential in similar projects of modernization and rationalization of regional lines are often not in focus. The whole set of rationalization measures in their logical relation and correct order will bring positive effect to all directly affected subjects. Under an exactly defined conditions it is possible to achieve these basic results:

- increase of upper track speed limit,

- increase of technical speed of trains,
- reduce of train running time,
- reduce of traffic time intervals,
- increase of railway infrastructure capacity,
- saving of salary costs a month is expected.

By these positive acting effects the rationalization of a railway transport operation and development of railway transport is the wide of attractiveness for the public transport, but in the end thanks to the more flexible freight operators and the attractiveness for shippers as well, it´s shown that one of the very clear way of adapting to rapidly evolving standards in railway transport is also the possibility of application of such measures like these.

LITERATURE

1. FLODR, F. ***Dopravní provoz železnic – Technológia železničných staníc.*** 1. vyd. Bratislava: Alfa, 1990. 320 s. ISBN 80-05-00598-9.
2. HALÁS, M. ***Návrh racionalizácie dopravnej prevádzky na trať ovom úseku Nitra – Leopoldov.*** Diplomová práca. Žilina: EDIS, 2011.
3. GAŠPARÍK, J., PEČENÝ, Z. ***Grafikon vlakovej dopravy a priepustnosť sietí.***1. vyd. Žilina: EDIS, 2009. 258 s. ISBN 978-80-8070-994-5.
4. MAŠEK, J. ***Organizácia železničnej dopravnej prevádzky počas výluky.*** Mladá veda 2008 - Veda a krízové situácie: medzinárodná konferencia mladých vedeckých pracovníkov: 4.-5.9.2008 Žilina. - Žilina: Žilinská univerzita, 2008. – elektronický optický disk, 7 s. - ISBN 978-80-8070-896-2.
5. KENDRA, M., NEDELIAKOVÁ, E., BABIN, M., BARTA, D. ***Rationalization of static transport.*** Transport and the environment (Vol. 2) : proceedings of the 9th SoNorA University Think Tank Conference (Bologna) : 19th of October 2011. - [S.l.: s.n., 2011]. - s. 15-33. - ISSN 1868-8411.

Authors:

Ing. Martin Halás - Department of railway transport, Faculty of operation and economics of railway transport and communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina. Tel.: +421-41-513 3428, E-mail: martin.halas@fpedas.uniza.sk

Ing. Vladislav Zitrický, PhD. - Department of railway transport, Faculty of operation and economics of railway transport and communications, University of Žilina, Univerzitná 8215/1, 010 26 Žilina. Tel.: +421-41-513 3406, E-mail: vladislav.zitricky@fpedas.uniza.sk

Ing. Peter Blaho, PhD. - Railways of Slovak Republic, The Central Institute of Education and psychology, 1.mája 34, 010 01 Žilina. Tel.: +421-41-2295353, E-mail: blaho.peter@zsr.sk