The Problems of Railway Infrastructure Modernisation and Their Influence on the Modernisation of Regional Routes

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Abstract. The article presents the assets of PKP PLK S.A. company as well as their infrastructural condition, which is undergoing decapitalisation. Current modernisation projects require feasibility studies. Those studies include issues related to modernisation, which in turn influence the efficiency of these projects. These issues have been discussed briefly. The problems of modernising low-traffic routes have also been presented.

Keywords: PKP PLK S.A., investment efficiency, feasibility study, modernisation issues, modernisation of low-traffic routes.

1 Introduction

PKP Polskie Linie Kolejowe (PLK) S.A. is one of the biggest administrators of railway infrastructure in Poland. Like any enterprise operating in the market, the company has certain assets. PKP PLK S.A. assets consist of fixed assets (86,4%), that include: land, buildings and facilities, civil engineering facilities, technical equipment and machines, tangible assets in progress, with advanced payments; remaining assets, as well as current assets (13.6%) include: reserves, receivables for supplies and services, tax, custom, insurance and other provisions, any other receivables, short-term financial assets, prepayments and accruals.

1.1 Restructuring and Rationalising the Assets

The process of bringing PKP S.A. assets required for railway route management to PKP PLK S.A. is gradual according to the provisions of the Act of September 8, 2000 concerning commercialisation, restructuring and privatisation of "Polish State Railway" state company. At the same time, the railway infrastructure is being adjusted for statutory activities. Any redundant assets are liquidated or transferred to local governments according to law.

Home investments produced a huge interest among entrepreneurs in reactivating railway traffic on routes that were already cancelled or decided to get cancelled. Following

J. Mikulski (Ed.): TST 2010, CCIS 104, pp. 59–66, 2010.

an economic analysis to show the profitability of this action, the Board of PKP PLK S.A. have agreed to regenerate more stretches or railway routes in recent years.

PKP PLK S.A., who is the main administrator of the railway infrastructure, assigned a basic goal to the remaining routes, i.e. to maintain the railway network in a condition allowing for safe railway traffic, maintain the quality of services and develop the infrastructure.

2 Railway Routes Operation

The distance of operated routes year by year (in 2008) has grown a little, which is a positive market trend. But network-wise, the most important goal for the administrator of the infrastructure is to provide the passenger and cargo carriers, as well as their passengers and consigners with a high-standard offer. That is why improving the technical condition of the infrastructure is a priority for PKP PLK S.A. Due to this, the maintenance and repair works conducted by the company are concentrated mainly on removing any speed limitations.

Table 1. The structure of scheduled speeds

The structure of scheduled speeds		
Speed ranges	Rail length (km)	Total rail length share
V >160 km/h	1.493	5%
120 < V < 160 km/h	4.011	15%
80 < V < 120 km/h	10.482	38%
40 < V < 80 km/h	9.259	33%
V < 40 km/h	2.534	9%
Total	27.779	100%

Unfortunately, the lack of finances to cover infrastructural repairs means that its condition is systematically deteriorating. When introducing new schedules, the length of rail sections with lowered scheduled speed exceeds by approximately 1,000 km the length of rail sections, on which this speed was increased. The scheduled speed structure in the 2008/09 schedule is presented in the Table 1.

Decreasing the scheduled speed in new schedules has not contributed to lowering the number of speed limitations nor to the length of reduced-speed sections. A comparison of reduced-speed rail sections in consecutive years is shown in Fig. 1.

In order to improve the technical condition of the infrastructure, increased repair and modernising works are required.

That is why the main aim of the modernisation is to improve the rail route parameters to meet the new standards and the requirements of the AGC international agreements (concerning main international railway routes) and AGTC (concerning the main railway routes in combined transportation).

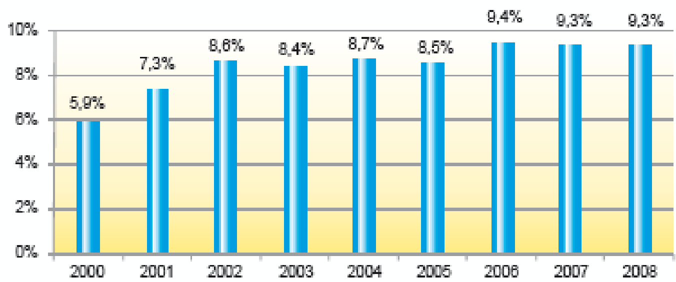

Fig. 1. The length of reduced-speed rail sections

The current and future modernisations are expected to increase the comfort and safety of rail transportation as well as decrease the maintenance cost. Modernisation will also contribute to environmental safety - all projects include provisions to protect the environment from noise, vibrations, soil and water pollution. The speed will be greatly increased by up to 160 km/h for passenger trains and 120 km/h for freight trains, and by using the Central Railway Line - up to 200 km/h. Modernisation of the railway network can also result in decreased traffic density on public roads.

3 Perspectives for Operated Railway Routes

The condition of Polish railway infrastructure has a significant influence on the development of Polish enterprise, new investments, the competitiveness of railway operators against road transportation and attracting individual customers. The process of modernising Polish infrastructure is insufficient. The estimated funds provided for this task cover only 20% of the required amount.

The necessary annual costs of infrastructure renovation, assuming a 10-year period needed to overcome the repair backlog while maintaining annual rail and turnout replacements caused by wear and tear, are 3.5 billion PLN to overcome the backlog and 1.2 billion PLN for current works. 2.2 billion PLN should cover the rail and turnout maintenance as well as diagnostics, while 250 million PLN should cover the costs of replacing heat-treated rails. This means that the annual costs for the next 10 years should amount to 7.150 billion PLN. Obtaining such an amount does not seem to be viable.

It is, thus, necessary to design a new concept of maintaining and modernising the infrastructure and, above all, of rational division of funds among maintenance and investments, including EU funds available in 2007-2013. In 2006, the European Union provided Poland approximately 25 billion euro for infrastructural investments during the current EU budget term. Increased funds, although still insufficient, have influenced the increased investments in PKP PLK S.A. as well as the development of products and services in this sector. Returning to the normal operating conditions on main routes is, however, still the most important element in the next 10 years. Investment policies should be changed to favour these works that result in the visible shortening of travel time for as many passengers as possible, getting rid of bottlenecks in the network and increasing investment in traffic automation. Apart from increasing infrastructural financing, cost rationalisation at PKP PLK S.A. is also necessary.

Unfortunately, the modernisation works as well as new investments in railway routes are progressing too slowly, making the overall improvement in infrastructure very small.

3.1 Railway Problems

As is the case in most European countries, the Polish railway network was formed when the railway transportation share in the overall transportation was the greatest. Any problems with supporting an extensive railway network were mostly caused by the decrease in transportation. In some cases, the question of the advisability of maintaining certain sections can be posed, but their cancellation or abandoning their renovation would still be a mistake.

The Feasibility Studies conducted so far have shown that there is a gap in planning the investments in the railway infrastructure. This results in a lack of an overall concept concerning the biggest railway junctions, which would answer the challenges and fit the plans of the city and agglomeration development.

Charges paid by carriers for accessing the railway infrastructure, while still insufficient to fully cover the cost of operation and maintenance of this infrastructure, also serve as an important economic factor to be considered. This poses a threat of unbalancing the cost of repair, maintenance and operation of the existing infrastructure with the national treasury contributions and proceeds from customers.

Abandoning the turnout, rail and ballast replacements as well as engineering maintenance along the routes, which should be performed periodically, as well as other repairs will cause the route parameters, especially the speed limits, for keeping transportation safe to deteriorate . As a result, the speed limit on many routes is less than that scheduled, decreasing the comfort.

The rolling stock should also be replaced in parallel to the modernisation, as the current stock is and will be insufficient to meet the prospected needs. So far, any purchases of passenger vehicles were made on a unit-by-unit basis (e.g. several diesel rail buses bought by Marshall Offices, passenger cars, a dozen electric locomotives for passenger trains) or were short EZT series (e.g. to operate city-to-city routes and push-pull trains). On a global scale, these purchases did not cover the losses in rolling stock, improved the offer in a limited and selective way, and introduced a variety of models, which is harmful for maintenance and repair purposes. There have been incomprehensible situations in the process, such as the purchase of modern push-pull trains or traction vehicles to be operated remotely, which means that these modern trains are pulled 1960s locomotives, while their own control rooms remain defunct. The manufacturers of passenger trains have repeatedly proposed more effective ways to purchase new rolling stock, such as long-term planning, series extensions and option purchasing. These possibilities were, however, never used.

4 Modernisation Opportunities

By analysing the network size, we can determine the potential market of low-traffic routes, where a simplified traffic control system can be implemented in the future. Route no. 27 between Nasielk and Sierpc, which is a part of the Nasielsk - Torun

Wschodni route, can be given as an example of a low-traffic route fit for further analysis. Even though there are only 4 stations along this route, this section is a good solution, as the Nasielsk station would be a combination (as a Local Control Centre - LCC) of a main line (E 65 Warsaw-Gdansk) with a low-traffic route operated by the LCC.

4.1 Section Characteristics

The Nasielsk - Sierpc section located along route no. 27 Naielsk - Torun Wschodni is 87.489 km long. It is a single-rail, non-electrified route with a speed limit of 100 km/h. Due to the degradation of rail infrastructure in the Nasielsk - Sieprc section, the trains have to slow down to 60 km/h.

There are 4 stations along this section: Nasielsk, Plonsk, Raciaz i Sierpc, as well as 10 passenger stops: Cieksyn, Wkra, Dalanowek, Arcelin, Baboszewo, Kaczorowo, Koziebrody, Zawidz Koscielny, Zawidz and Mieszaki.

The stations contain key mechanical equipment (2 stations), i.e. E and PB-type transmitters. Individual sections are equipped with automatic block systems with mechanical blocks. There are 5 station (cat. A) and 82 route (cat. D) railway crossings along the route.

4.2 Modernisation Variants

There are three variants for installing a simplified CTC system for low-traffic routes in this theoretically considered route:

- Variant I - implementing train control devices for main lines in this route, while modernising the infrastructure;
- Variant II - implementing simplified train control systems for low-traffic routes;
- Variant III - implementing simplified train control systems for low-traffic routes while modernising the infrastructure to overcome low scheduled speeds (below 40 km/h).

4.3 The Results of Variant Analysis

Calculations were made for the above variants to check the influence of individual works on the analysed indices that will vary as the works progress and will consist of the combination of different works. In case of variant I, it was assumed that the “full” CTC devices and category A and B crossings will be implemented in the stations, while in the case of variant B, simplified CTC devices and category A and C crossings are planned. The Table 2 presents a comparison of the projected expenses.

When analysing the values in Table 2, we can assume that:

- In case of the modernised railway infrastructure owned by PKP PLK S.A. on low-traffic routes, as far as financial matters are concerned, installing “full” (widely used) CTC devices are advisable. Considering the condition of current rail infrastructure (significant decapitalisation), this variant is not very viable, even though it is possible. Installation of simplified CTC devices (positive financial indices despite route decapitalisation) throughout the whole term of 30 years will result in future negative indices caused by necessary rail repairs (see Table 2).

Table 2. Investment expenses on the modernisation of the example low-traffic route

	Variant I (in thousands PLN)	**Variant II (in thousands PLN)**	**Variant III (in thousands PLN)**
Rails[1]		0,00	
Renovation of 100% rail length	153,729.00		60,366.60
Renovation of 75% rail length			47,243.70
Renovation of 50% rail length			34,120.80
Renovation of 25% rail length			20,997.90
CTC device installation	39,263.40	33,313.40	33,313.40
Telecommunication	40,439.53	40,439.53	40,439.53
Railway crossings (installation of automatic crossing signalling devices)[2]			
All crossings along the route	76,634.00	68,680.00	68,680.00
Every 2 km	39,939.00	35,962.00	35,962.00
Every 3 km	27,409.00	24,790.00	24,790.00
Every 4 km	22,039.00	20,002.00	20,002.00

- Low financial effectiveness of this investment means that it can only be justified by overall economic or social benefits. Such assessments should be made in economic analyses of individual projects for low-traffic routes.
- It is hard to determine the most beneficial investment variant based on the present analysis.

Due to the current under-financing of railway infrastructure, the main purpose of charging for the access to PKP PLK S.A. network is to generate revenue and maintain regional routes, making the charges for different types of trains unique in Europe (very low prices for passenger trains, very high prices for freight trains). It has to be considered that the future state financing of railway route operation as well as regional routes will approach European standards, resulting in reduced charges for freight trains in order to relieve road traffic and in possible increased charges for passenger transportation.

Due to the above factors, it has been checked how the indices will behave in case of a 15% increase in the listed charges throughout the whole period, while maintaining the current number of trains and increasing their number to 15 per day as presented in Table 3.

Based on the analyses, it has been found that it is still hard to determine the most beneficial investment variant after the charges are raised along with increased traffic, but it can be seen that any changes in these parameters influence the final values of the analysed indices. Variant III, which gets rid of bottlenecks and increases the speeds, is the one most affected. Due to the above factors, the decision concerning the installation of simplified CTC devices in low-traffic routes will have to be preceded by a detailed analysis of given investment circumstances.

[1] Repairs of certain rail sections is possible in Variant III to get rid of “bottlenecks”. That is why various rail portions are considered.

[2] Due to a large number of crossings along the example route, various numbers of crossing signalling devices are considered.

Table 3. A comparison of analysis results - current traffic

	Variant I			Variant II			Variant III		
	FNPV/C[3]	**FIRR/C**[4]	**B/C**[5]	**FNPV/C**	**FIRR/C**	**B/C**	**FNPV/C**	**FIRR/C**	**B/C**
1*	25,6	12.0%	1.8	11,3	9.2%	1.5	20,6	11.7%	1.8
2**									
min	-235,8	-10.41%	0.23	-114,4	-6.4%	0.3	-162,0	-8.1%	0.3
max	179	6.1%	1.10	11,3	9.2%	1.5	-2,4	5.5%	1.0
3***									
min	-400,5	∞	0.2	-114,4	-6.4%	0.3	-230,8	-13.6%	0.2
max	-139,2	-5.5%	0.4	11,7	9.2%	1.5	-2,8	5.5%	1.1

* – Installation of CTC devices[6]
** – Installation of CTC devices, telecommunication, crossings[7]
*** –Rail works, installation of CTC devices, telecommunication, crossings[8]

Table 4. A comparison of analysis results - increased charges and traffic

	Variant I			Variant II			Variant III		
	FNPV/C	**FIRR/C**	**B/C**	**FNPV/C**	**FIRR/C**	**B/C**	**FNPV/C**	**FIRR/C**	**B/C**
1*	48,411	15.77%	2.51	13,492	9.70%	1.59	41,010	15.73%	2.56
2**									
min	-212,9	-5.6%	0.3	-112,2	-5.5%	0.3	-141,6	-3.9%	0.4
max	23,0	9.3%	1.5	13,5	9.7%	1.6	18,0	9.0%	1.1
3***									
min	-377,6	-12.3%	0.2	-112,2	-5.5%	0.3	-210,4	-6.8%	0.3
max	-116,3	-2.0%	0.5	13,5	9.7%	1.6	17,6	8.9%	1.5

* – Installation of CTC devices[6]
** – Installation of CTC devices, telecommunication, crossings[7]
*** – Rail works, installation of CTC devices, telecommunication, crossings[8]

5 Conclusions

As has been shown above, the modernisation of low-traffic routes may seem economically unadvisable while keeping the access fees and traffic intensity on the same level.

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3 FNPV/C - financial net prezent value
4 FIRR/C - financial internal rate of return
5 B/C – benefit/cost ratio
6 Installation of simplified CTC devices with already modernised rail infrastructure.
7 Values for different combination of works, including the installation of simplified CTC devices with already modernised rail infrastructure.
8 Values for different combination of works, including the installation of simplified CTC devices.

When planning the modernisation of a given route, one has to conduct detailed economic analyses of several variants every time. When completing such analyses, one has to include potential changes to access fees as well as state or local funding of railway infrastructure.

A significant profit from modernisation is possible for many low-traffic routes, provided the correct variant is chosen and traffic as well as the access fees are increased.

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