

Infrastructure Improvement as a Means to Railway Transport Development in Poland

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The paper presents railway freight traffic in 1950-2007 in comparison with other branches of transport as well as the prevalence of motor transport. Railway infrastructure improvement should be performed in a wider extent because it already fulfills clients' basic transportation demands. Implementing railway interoperability increases its competitive power on transportation services market.

Key words: freight traffic, transport expectations, infrastructure improvement requirements, railway interoperability, services quality improvement.

1. FREIGHT TRAFFIC VOLUME DEVELOPMENT

The rates of freight traffic presented in the following paper developed during various administration periods in the state, ie. central management economy, as well as current market economy. Until the mid 50s', railway transport contribution to services market of land transport was prevalent. However, rapid development of vehicle transport along with its distinctive useful features surpassed the advantages of railway carriage. First, motor transport adopted most of load mass, and after in 1998 it also became a leader in transportation. Overall freight traffic development realized by means of various transport branches, including railway, in years 1950-2007 is comprised in two analytical tables:

- table 1 comprises information on freight traffic volume, expressed in mln tons;
- table 2 presents freight transport work volume, in bn tkm.

Analysing the volume of freight handled during that period via rail transport, in comparison with

other branches, one needs to notice its constantly decreasing tendency (table 1). Railway freight traffic in Poland reached its peak in 1978 of 489 385 thousand tons. An increase in railway transit of goods came in 2002 as a result of railway transport services market liberalization in the state.

In 2007 the share of rail carriage in general freight transport services market reached merely 16,0 %, of which PKP Group carriers' share - 62,6 %. Whereas motor transport participation was prevalent and constituted a considerable 79,2 % of overall transportation services market.

Freight transport works values demonstrate a similarly decreasing tendency in the years 1950-2007. Maximum transit was realized by PKP in 1978 and achieved 138,1 mld tkm. In 2007 railway freight transport share in general transportation services market equaled 20,3 % and proved a decreasing tendency when compared to rising volume of vehicular freight carriage (59,7 %), whose participation in the market points out a further stable growth (table 2).

Table 1. Freight transit in the transport system of Poland within 1950-2007

Freight transit	1950 ^{a)}		1965 ^{a)}		1980		1990		2000		2005		2006		2007	
	mln t	%	mln t	%	mln t	%	mln t	%	mln t	%	mln t	%	mln t	%	mln t	%
General, incl.:	342,1	100,0	939,0	100,0	2753,3	100,0	1645,5	100,0	1271,5	100,0	1422,6	100,0	1480,3	100,0	1532,7	100,0
rail, incl.:	160,4	46,9	341,3	36,3	482,1	17,5	281,7	17,1	187,2	14,7	269,6	19,0	291,4	19,7	245,3	16,0
PKP ^{x)} group	---	---	---	---	---	---	---	---	---	---	149,9	55,6	156,4	53,7	153,5	62,6
vehicular	110,0	32,2	569,4	60,6	2167,9	78,7	1292,4	78,5	1006,7	79,2	1079,8	75,9	1113,9	75,2	1213,2	79,2
pipeline	---	---	6,1	0,6	40,7	1,5	33,0	2,0	44,3	3,5	54,3	3,8	55,6	3,8	52,9	3,5
inland	1,2	0,4	4,7	0,5	22,2	0,8	9,8	0,6	10,4	0,8	9,6	0,7	9,3	0,6	9,8	0,6
sea	2,5	0,7	11,6	1,2	39,6	1,4	28,5	1,7	22,8	1,8	9,4	0,7	10,0	0,7	11,4	0,7
air	0	0	0,007	0	0,017	0	0,014	0	0,028	0	0,034	0	0,036	0	0,046	0

^{a)} Total value includes horsedrawn transport.

^{x)} Established in 2002. The interest rates were estimated in relation to general rail transit rate.

Source: Own analysis on the basis of *Rocznik Statystyczny 1971*, GUS, Warsaw and the publication *Transport – wyniki działalności*, GUS, Warsaw 2002 and 2008.

Table 2 Freight transit work in transport system of Poland within 1950-2007

Freight transit	1950 ^{a)}		1965 ^{a)}		1980		1990		2000		2005		2006		2007	
	mld tkm	%	mld tkm	%	mld tkm	%	mld tkm	%	mld tkm	%	mld tkm	%	mld tkm	%	mld tkm	%
General, incl.:	46,1	100,0	150,4	100,0	456,2	100,0	346,2	100,0	284,7	100,0	228,2	100,0	248,9	100,0	267,3	100,0
rail, incl.:	35,1	76,1	81,0	53,9	134,7	29,5	83,5	24,1	54,4	19,1	50,0	21,9	53,6	21,5	54,3	20,3
PKP group ^{x)}	---	---	---	---	---	---	---	---	---	---	43,8	87,6	44,3	82,6	43,6	80,3
vehicle	1,4	3,0	8,4	5,6	44,5	9,8	40,3	11,6	75,0	26,3	119,7	52,5	136,5	54,8	159,5	59,7
pipeline	---	---	3,2	2,1	17,1	3,7	13,9	4,0	20,4	7,2	25,4	11,1	25,6	10,3	23,5	8,8
inland	0,3	0,7	1,4	0,9	2,3	0,5	1,0	0,3	1,2	0,4	1,3	0,6	1,2	0,5	1,3	0,5
sea	9,1	19,7	56,4	37,5	257,4	56,4	207,4	59,9	133,7	47,0	31,7	13,9	31,9	12,8	28,6	10,7
air	0	0	0,006	0	0,030	0,01	0,057	0,02	0,088	0,03	0,107	0,05	0,110	0,04	0,098	0,04

^{a)} Total value includes horsedrawn transport.

^{x)} Established in 2002. The interest rates were estimated in relation to general rail transit rate.

Source: Own analysis on the basis of *Rocznik Statystyczny 1971*, GUS, Warsaw oraz publikacji *Transport – wyniki działalności*, GUS, Warsaw 2002 and 2008.

Railway freight traffic in 2008 and 2009 show a considerable drop of about 20-35 % which is the result of the economic crisis in Poland, though not all rail carriers equally perceive its effects. Decreasing tendency in freight traffic can be noticed with carriers of PKP Group, while growing trend is present with certain private carriers, e.g. CTL Logistics¹. Hopefully, further development of freight transport in Poland will follow a balanced

transportation system development, anticipated in European Community transportation policy as well as in the record 'State transport policy for 2006-2025'.

2. RAIL SERVICE CLIENTS TRANSPORTATION DEMANDS

The expectations are desiderated by transport clients with regard to the manner of their fulfillment. Transport expectations constitute the

¹ F. Nietz, CTL zdobywa rynek, „Polska Gazeta Transportowa” nr 26 z 1 lipca 2009 r. s. 1.

stated transportation services quality. The number and types of submitted demands are unlimited and start from fundamental demands like transport safety and speed. Most significant demands determine current tendencies in realizing services also encompass: massive character, affordability, direct delivery, availability, reliability, as well as comprehensive aspect of transport service²

Safety requirement refers to both passengers and freight traffic. Cargo protection and appropriate realization of transportation degree – considering its quantity and quality – during transit, transshipment and storage works should guarantee full maintenance of its functional and trade value after completing the transportation choice of a carrier is conditioned by the confidence of his reliability.

The speed demand is required throughout the entire transportation process, thus not only with passengers or freight transport by standards conveyance but also with regard to destination and return means, and transshipment time, or handling and storage in conveyance shift stations. The demand realization is also influenced by international, clients expect comprehensive potentially longer transit route, also in rail transport.

Mass demand defines anticipated quantity of a single transit or the entire transfer. It refers mainly to passengers transport e.g. commuting to work or school, getting to cultural and sport events as well as the delivery volume of particular part of a consignment, or the entire cargo also in mass scale. The demand realization is dependent on rail transit capability (rolling stock, transit route).

Affordability demand determines maximum transportation charges that a client is ready to incur, considering e.g. load economical transit flexibility. The lower the flexibility, usually due to its value, the more mandatory the affordability demand.

Direct delivery demand defines a tendency to execute transit in a direct transportation process of both people and freight, which considerably shortens transit time, prompts delivery, increases the safety level and results in lowering general transport costs. The demand is most often realized in rail transport in 'siding – siding' relation.

3. RAIL INFRASTRUCTURE IMPROVEMENT REQUIREMENT

Financial imbalance of PKP enterprise has been present for many years now. Main reason for this was only a partial grant of the actual passengers carriage budget, which resulted from different budget grants admitted and due to PKP. In 1990 admitted grant equaled 3535,3 bn pln, and due grant was 5549,2 bn pln; PKP enterprise received only 63,7 % of due grant. Whereas in 1993 the

² See also W. Rydzkowski, K. Wojewódzka –Król, (red.), Transport, Wyd. Naukowe PWN, Warszawa 2007, s. 34-36.

grant was only 44,0 % of due 14 738,0 bn pln of the state budget³.

Difficult PKP enterprise situation is due to underfunding, which became the direct cause of progressive decapitalization of assets, namely transport infrastructure including engineer constructions. In 1990 the degree of rail infrastructure needs satisfaction, including track renewal was only – 37,7 %⁴. For that reason, a decision was made to fix financial outlays on maintaining technical condition of basic network railway lines which operated as much as 80 % of loads and passengers transport, whereas other lines should be exploited until their mechanical consumption time (approx. 8 500 km).

In 1995, owing to still present PKP enterprise financial problems, only 616km of tracks were renewed, that is about 33% of total track length which should have been changed in a year. In 1998 technical condition and physical consumption of rail infrastructure facilities became a serious issue because 85 % of its components had been exploited for at least 80 years⁵. In July 1998, PKP enterprise managing board decided to take legal action against State Treasury due to non-payment of due grants. Profitable freight traffic covered in over 50 % the costs of loss-making passengers transport. Insufficient government grants for passengers transport (the grant admitted in 1997 of 710 mln pln covered 24 % of the overall financial needs estimated at 2,92 bn pln) caused PKP enterprise to be in a very difficult financial situation⁶.

Soon, in order to improve PKP financial situation, legislative processes were initiated. For instance law art. no 79 of the act on commercialization, restructuring and privatization of PKP⁷ determined financial means for regional and interregional transport of passengers (unranked) which were supposed to be comprised in budget acts for 2001-2005. However, difficult budget situation and government change in in 2001

resulted in reducing the grant anticipated for 2002 – 500 mln pln, and for 2003 – 800 mln pln, to 300 mln pln, whereas in practice considerably lower; subsequently the act considering further grants for years 2004-2005 of at least 800 mln pln was rescinded by the legislator on 29th Nov 2003.

Track sections length with a reduced train speed in 2000 was 2515 km, and in 2003 already 3246 km⁸. Liquidation cost in 2006 wszystkich ograniczeń prędkości on the lines of PKP Polskie Linie Kolejowe/Polish State Railways (PKP PLK) was estimated at 4 500 mln pln⁹. At the end of 2007 there had been 7501 train speed limits introduced into PKP railway network on the distance of 3967,618 km, usually on route and main station tracks. The length of railway lines in 2007 was 20 107 km and was shorter by 6 121 km (-23,3 %) when compared to year 1990¹⁰; there were 11 898 km (60,1 %) of electrified standard-gauge lines.

In order to improve the technical state of railway infrastructure it is necessary to increase the number of tracks and crossovers renewal. The growing tendency in this area was particularly noticeable after Poland's access to the European Community. Track renewal increased from 180 km in 2004 to 699 km in 2007 with an average annual track renewal demand of 1390 km, not performed since 1991. Track renewal overdue in years 1991-2007 are presented in figure 1. Similarly, there was an increase in the number of crossovers renewal, which in 2007 reached the number of 453 pieces, with an average annual renewal demand of 2490 pcs¹¹. The overdue in maintenance and development also concerns many engineering facilities whose technical condition is systematically aggravating. However, one must

⁸ PKP PLK S.A., Raport Roczny 2002, Warsaw 2003, s. 17.

⁹ PKP PLK S.A., Raport Roczny 2006, Warsaw 2007, s. 67.

¹⁰ Not all UE countries perform only rail lines suspension – in years 1995-2007 their length increased e.g. in Spain of 14291 km by 721 km (+ 5,0 %), in Italy of 16 003 km by 664 km (+ 4,1 %), and in Britain of 17 069 km by as much as 2887 km (+ 16,9 %, 2006 r.), also in Austria, the Czech Republic and in Hungary (EU European Commission, Energy and Transport in figures, Statistical pocketbook 2009, s. 149, tab. 3.5.3).

¹¹ PKP PLK S.A., Raport Roczny 2007, Warsaw 2008, s. 89.

³ Dyrekcja Generalna PKP, Nasza kolej, dlaczego i jak ją restrukturyzować, Warszawa, październik 1994, s. 11.

⁴ Ibidem, s. 15.

⁵ DG PKP, Raport Roczny PKP 1998, Warszawa 1999, s. 31.

⁶ P. Apanowicz, Kolej skarży skarb państwa, „Rzeczpospolita” 1998, nr 170.

⁷ Dz. U. nr 84, poz. 948.

add that also the laws of art. 21, act 1, dated Jun 27th 1997 on rail transport and art. 38 of the next impression of the act declare that state budget is responsible for investment and maintenance of nearly 12 thousand km of state significant railway lines in Poland¹².

Naturally, most track renewal is conducted in paneuropean transportation corridors and has already been in progress for several years. One of the examples of transport service quality impairment in the section of another meaningful rail line, e.g. Bydgoszcz-Tczew of 128km, is a considerable travel time extension of i.a. express train 'Bałtyk', which covers the distance in scheduled time of 152 minutes (7.53-10.25), at some sections developing as much as 40 km/h¹³, whereas 25 years ago the speed limit was 120 kph. A question arises of when will other rail lines be modernized, which once serviced regional and municipal centres in Poland? Current rate of track renewal in major transportation routes allows only to inhibit rail infrastructure depreciation process.

An immense potential of PKP PLK, 18 993 km of rail lines (31st Dec 2007) particularly at present – congestion in motor transport – should be modernized more promptly. Depreciation of such potential leads directly to transport service quality depreciation and consequently, due to services demand drop, to transport services suspension over a particular state's territory. In such a case present demand for those services will be satisfied – at present time – through widespread individual motorization of our society, instead of collective rail transport, still free of congestion.

Current railway condition in Poland, including road infrastructure is also an issue of the public appeal of Railway Business Forum in Warsaw directed to the Prime Minister of Poland on Jul 1st 2009, in which the authors – science and politics personages – state directly that 'current situation of rail transport threatens economic stability of the state and its energy safety'. Progressing

technical deterioration of rail infrastructure leads to:

- average trade speed of freight trains statistically oscillates around 20 kph;
- bad technical condition of rail lines in Lower Silesia impairs the transit of breakstone and other aggregate from the local quarries to road building sites, including motorways under preparation for EURO 2012;
- potential clients of PKP PLK company take a dislike to its services not only because of their low quality but also due to very high prices¹⁴.

4. RAIL INTEROPERATIVENESS CRUCIAL FOR INFRASTRUCTURE MODERNIZATION

Railways development in particular European countries proceeded in various ways. Although fundamental rules remained unchanged the very rail infrastructure systems are different both technically and organizationally. The differences mainly regard:

- railroad, most particularly tracks and loading gauges width;
- braking and traction powering systems;
- rail traffic control systems.

Further economic and social development of EU countries requires more frequent facilitations in rail transport, both passenger and freight. The thrive of European authorities to design a uniform and effective European railway system resulted in formulating and implementing the directives of European Parliament and EU Council on railway system interoperativeness inside the Community; the latest being the directive 2008/57/WE from Jun 17th 2008, applicable to both standard railways and to high speed trains¹⁵.

According to the text of art. 2 b) of this directive, railway interoperativeness means system capability to ensure safe and continuous transit of trains complying with required level of efficiency. The capability is dependent on legal, technical and operative conditions which must be ensured in order to meet fundamental requirements. The

¹² Dz. U. nr 96, poz. 591 oraz Dz. U. 2003, nr 86, poz. 789. Szerzej - A. Burak, Ustawa nakazuje, rząd nie płaci, „Rzeczpospolita” 2005, nr 10.

¹³ Online Train Schedule 2008/2009, Wyd. PKP PR, Warsaw 2008, s. 507 and M. Tusk, Wolno, coraz wolniej ..., „Gazeta Wyborcza Trójmiasto”, 24.02.2009 (www.rynek-kolejowy.pl – 26.2.2009).

¹⁴ www.rynek-kolejowy.pl – 1 lipca 2009 r.

¹⁵ Dz. Urz. UE, L, nr 191 z 18 lipca 2008 r.

requirements mentioned are determined in Technical Specifications of Interoperativeness (TSI) for particular rail interoperativeness subsystems. Two subsystems are distinguished:

- structural, encompassing infrastructure, energy, controlling and rolling stock,

- exploitation – rail traffic, maintenance and telematics applications for passenger and freight transport (appendix II of the directive).

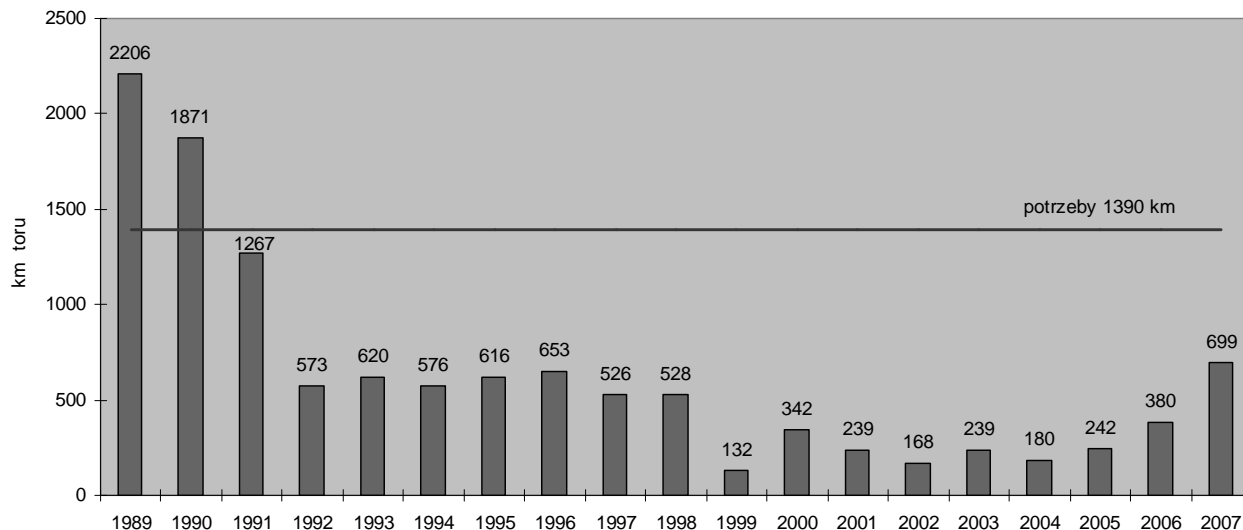


Fig. 1. Scale of track renewal within 1989-2007

Km toru – track km, potrzeby – requirements

Source: PKP Polish State Railways S.A., *Raport Roczny 2007*, Warsaw 2008, p. 89.

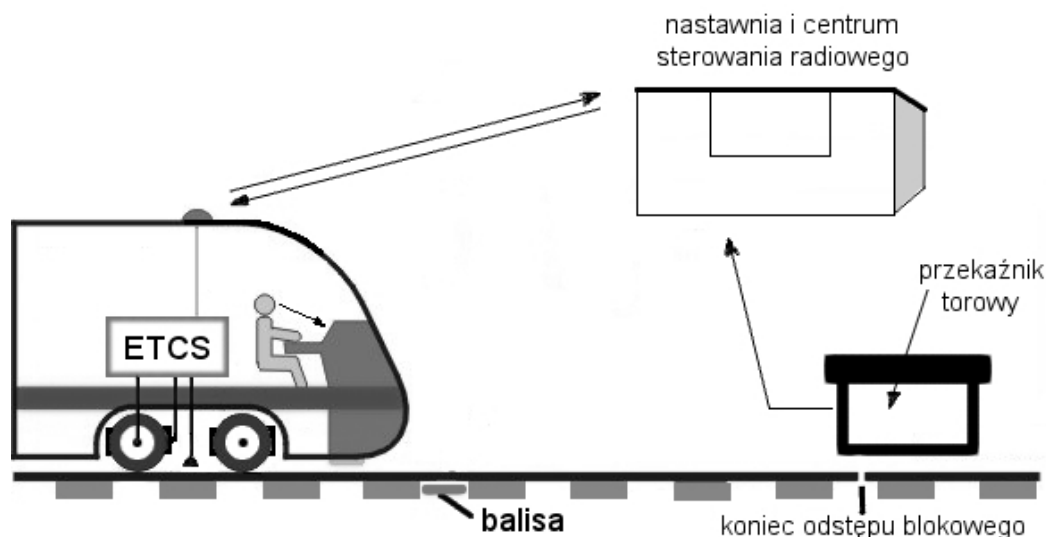


Fig. 2. Overall scheme of ERTMS/ETCS Level 2 system

Nastawnia – control station, Centrum sterowania radiowego – radio control Centre, Przełącznik torowy – track transmitter, Balisa – balise, Koniec odstępu blokowego – track end

Source: Own analysis by A. Toruń, M. Pawlik, *Informatyczne systemy bezpieczne. Kierowanie i sterowanie ruchem kolejowym*, „Problemy Kolejnictwa”, Zeszyt 133, CNTK, Warsaw 2001, p. 76.

TSI specifications determine fundamental technical and functional requirements for these subsystems. Due to complex character of the issue in question as well as high costs of implementing interoperativeness of rail network TEN-T, it is much time consuming. Introducing the European Railway Traffic Management System (ERTMS) encompasses two systems:

- Global System for Mobile Communication - Rail (GSM-R), ie train mobile communication,
- European Train Controlling System (ETCS) which distinguishes three control levels.

ETCS system level 1 is a specific 'overlay' on already functioning, standard rail traffic control system which uses daylight signal and track engagement monitoring devices. Between track, in determined places (spaces) in the track eurobalises are installed¹⁶. A train equipped with an aerial to receive the transmission from the balises gets information on the permission to drive, and the nearest section character to the driver's cab. In this way the engine driver also acquires data on maximum speed in this section of a line which is located between successive eurobalises.

In ETCS system level 2 the train instrument cluster communicate with rail traffic control centre already with the use of GSM-R, whereas in-track balises become autonomic devices whose function is to position the train. Tracks character is pre-programmed in the board computer. Control centre gives driving clearance and sends it directly to the train via radio communication. The computer calculates the speed and determines the next potential train stop point.

ETCS level 3 is different from level 2. On traction engine (element) it possesses an installed system for monitoring train set integrity. If the train set is severed the board system will inform both the engine driver and the control centre of the situation. The function of eurobalise comes down to being an electronic mileage post. The remaining board instruments do not change their function. The capability to send frequent radio clearance

update allows to increase the number of trains going in the same direction and on the same track¹⁷. The cooperation between in-track eurobalises, the train set, and the control centre is schematically comprised in figure 2.

The introduction of ERTMS controlling system in Poland is anticipated for Central Arterial Line (E 65) and at the section of line C-E 30 from the branch off point Bielawa Dolna (state border) to the station Legnica, at the same time in the first of the lines mentioned infrastructure administrator - PKP Polish Rail Lines – is going to introduce ETCS system level 1, in the second line – level 2. Line E 65 in the southern part (CAL) is to a large extent charged with passenger trains, whereas the western part of line C-E 30 with freight trans, operating large export transit from Upper Silesia to Germany, France, and other countries in West Europe. Implementing interoperativeness systems to particular rail lines will increase their traffic capacity, shorten the passenger and freight transit time creating favourable development conditions for rail transport and inter-branch competitiveness, e.g. air and vehicular.

5. SERVICE QUALITY AS A MEANS TO RAIL TRANSPORT DEVELOPMENT

Rail infrastructure modernization process, as well as introducing rail interoperativeness, contribute to the improvement of transport services quality, and consequently to the increase of their competitiveness on increasingly complex transport services market. The notion of quality is opposed to quantity¹⁸. In branch literature quality is not explicitly defined. After one definition, quality is a total of goods or a service features, deciding on particular product's capability to satisfy certain needs. The supplier can thus offer products of a determined value which meet client's expectations or exceed them. Quality ceases to be a distinctive feature on contemporary market but it becomes an integral part in competition struggle¹⁹.

Difficulties to define service quality explicitly, including transport services, are the result of a

¹⁶ Balise (French 'balise' – traction transmitter), it is a radio transmitter conveying information to the train, e.g.: its localisation, next section alignment (curves, slopes), speed limits; usually installed in pairs in order to determine direction A-B or B-A.

¹⁷ www.ertms.com. – 20.6.2009.

¹⁸ Nowy leksykon PWN, Wyd. Naukowe PWN, Warszawa 1998, s. 703.

¹⁹ J. Perenc (red.), Marketing usług. Wybrane aspekty, Wyd. Naukowe US, Szczecin 2005, s. 182.

dynamic and at the same time historic character of the notion of quality as the result of technical and technological changes and population culture. Service quality can be assessed by means of various markers which can be measured or defined. Services quality features are usually evaluated by:

- clients (consumers), constituting external part of the evaluation process (anticipated quality) and
- service providers (carriers), as an integral part (rendered quality).

The demands for transport qualities and the degree of their gratification by carriers in particular branches of industry were discussed earlier in the paper.

A deciding factor for rail transport services market development, both passenger and freight, is rail infrastructure modernization because its exploitation parameters directly affect particular elements of rail carriers services offer. The assessment of transport service quality degree and associated criteria relate to fundamental features of service performance, such as:

- transport subject- criteria i.a. trust and honesty, transit security, passengers comfort and service providers competence as well as information on carrier's services;
- transport route – functional parameters of a route along with its character e.g. easy access to transportation point, direct transport, proper technical capacity;
- workforce - criteria: politeness, competency, actions efficiency, responsibility;
- work means and associated e.g. quantity and quality of rolling stock, stock and loading devices exploitation degree;
- transportation process organization, including quality features - reliability, demands knowledge and service performance accuracy, the state and fittings of service provider station.

Not all results of transport services quality improvement are always directly measurable economically. They are for instance: lowering the expenses issuing from shortening transportation cycle time and associated floating assets freeze during transport, or reducing storage costs in

regular transport service. Improved quality of passenger transport can be noticed in shorter travelling time, improved travel comforts e.g. direct train or car, and also in the politeness and competence of passenger service by carrier's personnel.

Notable effect of transport services quality improvement by a carrier is reducing the number of complaints and compensation for product damages, overdue transport time or passenger's delayed travel. On the basis of this information, it is possible to conduct periodic analyses, bearing in mind the necessity to point out the means of service quality improvement in one's own enterprise. Recognizing service quality issue by particular rail carriers and other branches of transport reveals the assumed development course, with consideration for improved client service, both in passenger and freight transport, most often caused by increasing competition on inter-branch transport services market.

CONCLUSIONS:

1. Considerable increase of renewal potential of rail infrastructure in order to:
 - forward rail lines modernization in paneuropean transportation corridors,
 - start repair works, including spot works on remaining rail lines to sustain previous transport capability,
2. Use the present rail transport potential more extensively since its infrastructure has not yet been charged with transport congestion. Gradually introduce european systems for rail traffic management improvement in order to increase capacity of most heavily charged lines.

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