ANTUN STIPETIĆ, D. Sc.
E-mail: antun.stipetic@fpz.hr
JASNA BLAŠKOVIĆ ZAVADA, D. Sc.
E-mail: jasna.blaskovic@fpz.hr
University of Zagreb,
Faculty of Transport and Traffic Sciences
Vukelićeva 4, HR-10000 Zagreb, Republic of Croatia

Traffic Infrastructure
Preliminary Communication
Accepted: Nov. 11, 2005
Approved: Jun. 20, 2006

INFLUENCE OF RAILWAY TRAFFIC ON THE PAN-EUROPEAN CORRIDOR V.B ON THE DEVELOPMENT OF THE PORT OF RIJEKA

ABSTRACT

Considering the traffic development of Croatia and the wider traffic environment, special significance lies on the development of the Port of Rijeka and its traffic connection with the hinterland. The planned and necessary increase of the capacities of the Port of Rijeka requires adequate support by the rail and road traffic towards the interior of Croatia and other parts of Europe. Here, the support of the rail traffic is of special significance, regarding its advantages over road traffic. The work analyses the demand for transport of goods and passengers in rail traffic on the pan-European Corridor V.B in the present and the planned circumstances in the future. The work analyses the forecast of the transport of goods and passengers for the period until 2020 as part of the planned development of the Port of Rijeka. Based on this development a possible improvement of rail connection of Rijeka and the interior of Croatia and East Europe is proposed.

KEY WORDS

railway traffic, pan-European corridor V.B, port of Rijeka, planned development

1. INTRODUCTION

The traffic development of Croatia and its connections with other parts of Europe and the world require the development of all branches of traffic and their mutual complementation. In the traffic and economic development of Croatia, the development of the Port of Rijeka and its traffic connections with the interior and other parts of Europe, especially its eastern part, is of special significance. The advantages of rail transport of goods and passengers compared to other branches, emphasise the significance of high-quality connections on the pan-European Corridor V.B. Since the technical and exploitation parameters of the present railway line on this corridor, Rijeka-Zagreb-Botovo (Hungary) do not meet the advanced world traffic criteria, this route requires modernization. This would enable further development of the Port of Rijeka and contribute to the traffic integration into the integral traffic system of Europe.

2. DEMAND FOR TRANSPORT IN RAILWAY TRAFFIC

2.1. Demand for transport of goods

In considering the demand in the transport of goods it should be taken into consideration that all the tendencies in the area of transport demand will be under the influence of the social and economic flows. The development cycle will be reflected mainly on the infrastructure, especially traffic infrastructure (high-speed railway lines, motorways, navigable canals and cargo terminals). It should be taken especially into consideration that economic restructuring does not result in building any new economic gigantic facilities, but will rather transform the existing ones based on privatisation into minor high-profitable and environmentally friendlier plants. This will eliminate from the transport market some of the classical transport-intensive manufactures, e. g. huge ironworks, coke plants, chemical industries, etc.

One should also keep in mind that the general economic flows will evolve in an integrated Europe, free of conflicting situations, and the economic growth and development rates will be stable and moderate. The demand for services in cargo transport will grow moderately and uniformly in accordance with the economic structure development, both of Europe as well as of the world community. This means that the exchange will occur on the basis of extensive division of labour in international dimensions. In the long run, the railway cargo transport in Europe will become rec-

ognized and regain a significant place on the liberalized market.

It is realistic to expect an even much more dynamic increase in the international transit, especially on the pan-European Corridor V.B between the Adriatic and the central Danube basin region, since vital modern traffic routes are expected to be completed in this corridor.

Mass transport of goods will lose in significance, but there will be new requirements on the transport market oriented to the transport of high-value goods, especially in container and piggyback transport.

In the future the most intensive transit is expected on the pan-European traffic corridor V.B on the relation Koprivnica (s.b.) - Zagreb, since several transit routes converge, the busiest of which is the port transit of the Rijeka route, and then surface transit via Dobova into Slovenia and western Europe from Hungary and the eastern countries.

2.2. Demand for transport of passengers

The tendencies of the transport demand in passenger traffic are significantly influenced by the political and social, and social-economic circumstances in the close environment and wider in relation to the observed geographic area. Since macro-dependent circumstances change over time, they are also reflected on the tendencies of transport demand in passenger traffic, which is otherwise much more sensitive to the political and safety disturbances than goods transport.

One of the main levers of future development of Croatia is based on the dynamic and versatile development of tourism, especially on the Adriatic coast and islands, implying the origin-target traffic of tourists, more the foreign ones than the domestic ones.

Croatia has great tourism potentials which require, however, profound modernization and support through all aspects that would contribute to greater utilisation of these potentials. The modernisation of railway transport route on the pan-European Corridor V.B plays a significant role in this process.

Apart from the usual categories of internal traffic, the travelling along this corridor counts mostly on holiday passengers, domestic and foreign tourists, especially from the eastern countries.

3. FORECAST OF RAILWAY TRANSPORT

3.1. Forecast of cargo transport

The railway cargo traffic on the pan-European Corridor V.B is closely connected with the development of the Port of Rijeka. The Port of Rijeka generates about 90 per cent of the overall railway traffic in the Rijeka junction. Therefore, the development concept of railway and port means needs to be harmonised and in compliance with the market requirements.

According to the "Preliminary Design of the Rijeka Railway Junction" from 1986 a forecast of cargo traffic is given for the new valley railway line Rijeka-Zagreb for 2020 in the amount of 23.882 million tonnes [1].

The forecast of the railway cargo traffic according to the new development concept for the railway junction Rijeka has been given in the study "Redefining of traffic and spatial solution – Railway Junction Rijeka" from 2002. The adopted forecast of traffic in the Rijeka railway junction consists of two parts: forecast according to the study RMG (Rotterdam Maritime Group) and forecasts for other parts of the junction and terminals not considered in the study. The forecast of operation at the Rijeka railway junction and on other localities of the Rijeka junction is given in Tables 1 and 2 [2].

The forecast for 2010 is railway transport of about 85 per cent of goods transloaded at the Port of Rijeka, and 90 per cent in 2020 [2]. The forecast of the total public port transloading and the part of transloading oriented to the railway transport is presented in Table 3. [2].

According to the forecast of traffic at the terminals regarding travelling direction (loading and unloading of goods) the Port of Rijeka will continue to be mostly port of import. The share of loading in the total forecast traffic ranges from 65-68 per cent [2].

"The Traffic Development Strategy of the Republic of Croatia" from 1999 includes a forecast of the flows of the carried passengers and goods for 2020 at HŽ (Croatian Railways) per sections, i. e. per traffic corridors, as presented in Figure 1 [3].

The Figure shows that the most part of the total amount of forecast transport, more than 90 per cent, will be realised on the routes which are parts of European traffic corridors, forming less than 50 per cent of the total length of railway lines in Croatia.

Most of the cargo traffic is expected on the pan-European Corridor V.B state border /Botovo–Zagreb–Rijeka and estimated at 9.5 ÷ 12.5 million tonnes (depending on the section).

The biggest generator of transport demand on the pan-European Corridor V.B is the Port of Rijeka. The capacity of the port for transloading is more than 7 million tonnes of cargo annually. The plans forecast an increase in the capacities to over 15 million tonnes of cargo annually.

The forecast of cargo traffic on the pan-European Corridor V.B is presented in Table 4 and in Figure 2 [3].

Table 1: Forecast of operation at the Rijeka railway junction in 000 [t]

Year	Three biggest terminals	Other terminals	Total (RMG study)	Total – other localities at the junction	Total operation at the junction
2010	4,559	1,571	6,130	1,049	7,179
2020	7,285	2,483	9,768	1,159	10,927

Table 2: Forecast of operation at other localities at the Rijeka junction in 000 [t]

Year	Port background warehouses	Industrial zone Kukuljanovo	Terminals at Raša	Local operation gravitating to the railways	Total work other localities at the junction
2010	500	220	70	259	1,049
2020	550	250	90	269	1,159

Table 3: Forecast of total public transloading of the port and part of the transloading oriented to railway transport

Terminal	Forecast of total public port transloading		Forecast of railway traffic	
	2010	2020	2010	2020
Container and RO-RO terminal	689,000	1,100,000	585,650	990,000
Terminal for cereals and oil crops (silos)	500,000	600,000	425,000	540,000
Terminal for iron ore and coal Bakar	2,526,000	4,141,000	2,147,100	3,726,900
Terminal for artificial fertilizers	70,000	100,000	59,500	90,000
Terminal for fruit (refrigeration plant)	40,000	50,000	34,000	45,000
Terminal for cattle Bršica (Raša)	70,000	90,000	59,500	81,000
Terminal for liquid cargo	50,000	50,000	42,500	45,000
Plant of conventional cargo (Rijeka)	735,000	577,000	708,400	392,400
Plant of conventional cargo (Sušak)	220,000	250,000	187,000	225,000
Background warehouses Škrljevo-Kukuljanovo	500,000	550,000	500,000	550,000
Industrial zone Kukuljanovo	220,000	250,000	22,000	250,000
Terminal for timber	300,000	400,000	255,000	360,000
Zagreb quay (new terminal)	1,000,000	2,500,000	850,000	2,250,000
Other local traffic of Rijeka railway station	259,000	269,000	259,000	269,000
Total public port transloading (dry cargo)	7,179,000	10,927,000		
Out of which transported by railway			6,134,650	9,814,300

3.2. Forecast of passenger transport

Increased traffic on the railway lines towards the Adriatic, especially the Rijeka route, is not based only on the stronger Adriatic orientation of Croatia, but also on greater opening up of the eastern countries, starting from Russia, Ukraine, Poland, and the countries of the central Danube basin, towards the European Union countries and the Adriatic maritime navigable corridor. The increase in passenger transport is expected also due to the development of tourism and the improvement of the quality of services in railway transport. Table 5 and Figure 3 give the forecast of the passenger transport on the pan-European Corridor V.B [3]. It is obvious that on this route, depending on the section, passenger transport in the amount of 1.6 ÷ 7.7 million annually is expected.

4. SIGNIFICANCE OF PAN-EUROPEAN CORRIDOR V.B FOR THE DEVELOPMENT AND DEVELOPMENT PROJECTION OF THE PORT OF RIJEKA

The Port of Rijeka is the origin and the destination point of the transversal pan-European Corridor V.B. It represents the most important Croatian port for the transit of goods via the Croatian transport system.

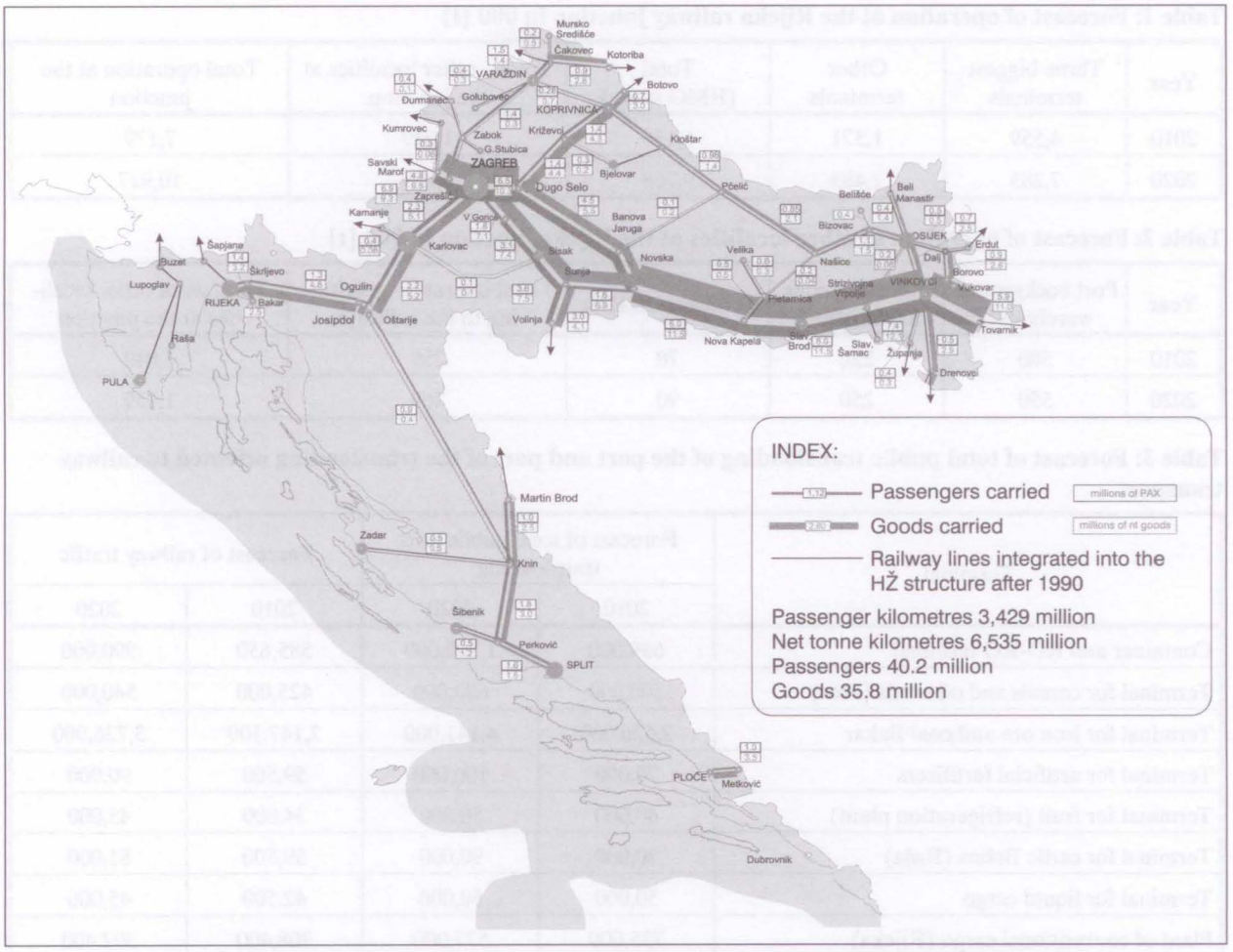

Figure 1 - Forecast of the flows of transported passengers and goods for 2020 at HŽ

Table 4: Forecast of cargo traffic on pan-European Corridor V.B

Rlw line No.	Rlw line name	2010	2020	2030
		Net tonnes annually in millions [t]		
MG 1 MG 1A	S.b.-Botovo-Zagreb-Rijeka S.b.-Koprivnica	4,578	6,400	7,070
	Koprivnica-Križevci	6,080	8,500	9,389
	Križevci-Dugo Selo	6,223	8,700	9,610
MG-1B	Dugo Selo-Zagreb GK	2,503	3,500	3,866
MG-1C	Zagreb GK-Rijeka Zagreb-Karlovac	8,941	12,500	13,808
	Karlovac-Oštarije	8,369	2,000	2,209
	Oštarije-(Moravice)-Škrljevo	7,797	2,000	2,209
	Škrljevo-(Kukuljanovo)-Rijeka/ (Moravice-Lokve)	7,797	9,500	10,494
	/Lokve-Škrljevo	7,797		
	/Škrljevo-Rijeka	6,795		
NP	Karlovac-Josipdol (NP, tunnel)		10,000	11,046
NP	Josipdol-Drežnica-Tijani (Rijeka)		10,200	11,267

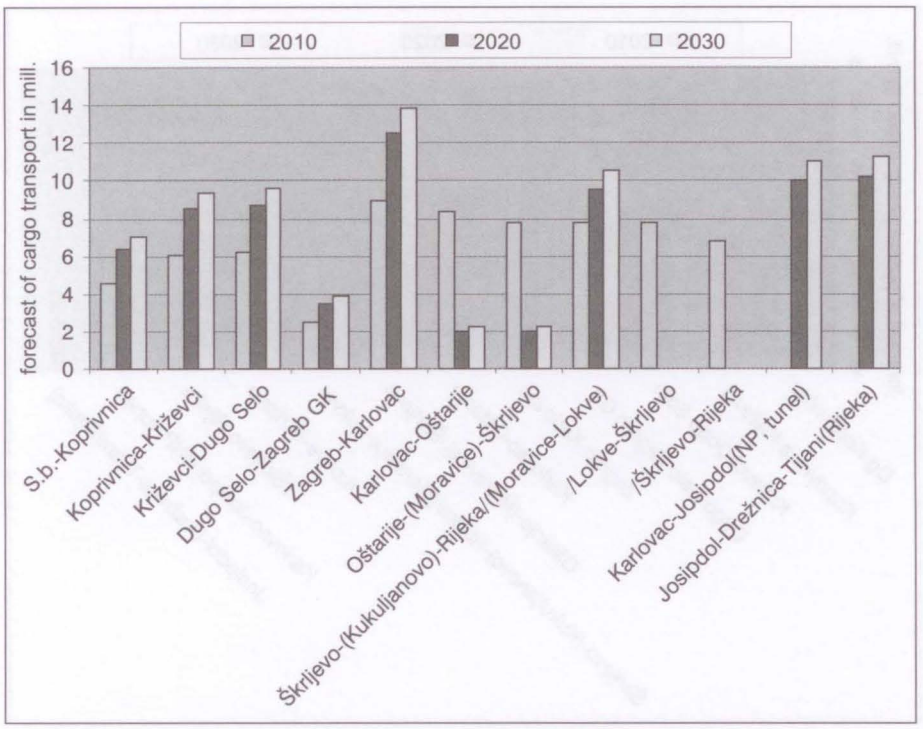

Figure 2 - Forecast of cargo traffic on pan-European Corridor V.B

Table 5: Forecast of passenger transport on pan-European Corridor V.B

Rlw. line No.	Rlw. line name	2010	2020	2030
		Passengers annually [millions of PAX]		
MG 1	Sb-Botovo-Zagreb-Rijeka Dg-Koprivnica	1,566	2,000	2,209
MG 1A	Koprivnica-Križevci	3,131	4,000	4,418
	Križevci-Dugo Selo	3,914	5,000	5,523
MG-1B	Dugo Selo-Zagreb GK	6,027	7,700	8,506
MG-1C	Zagreb GK-Rijeka Zagreb-Karlovac	4,305	5,500	6,075
	Karlovac-Oštarije	3,623	0,900	0,994
	Oštarije-(Moravice)-Škrljevo	1,992	0,800	0,884
	Škrljevo-(Kukuljanovo)-Rijeka/(Moravice-Lokve)	2,092	2,800	3,093
	/Lokve-Škrljevo	2,092		
	/Škrljevo-Rijeka	2,192		
NP	Karlovac-Josipdol (NP, tunnel)		3,800	4,198
NP	Josipdol-Drežnica-Tijani (Rijeka)		2,400	2,651

The Port of Rijeka generates in transit about 90 per cent of the entire railway traffic. Austria, the Czech Republic and Slovakia and Hungary are of great significance as part of this traffic via the Port of Rijeka. The structure of transport consists mainly of bulk cargo in the share of about 80 per cent of the entire transit.

This confirms the significance of the port and the respective traffic route on the pan-European Corridor V.B in performing the port activities for the Central European countries.

Transit traffic is of special significance in the economy of every country, since it indicates the achieved level of direct integration into the international traffic and exchange. This determines also the level of integration of the integral economy on the world market. Such traffic increases the international significance of individual ports and the competition in attracting

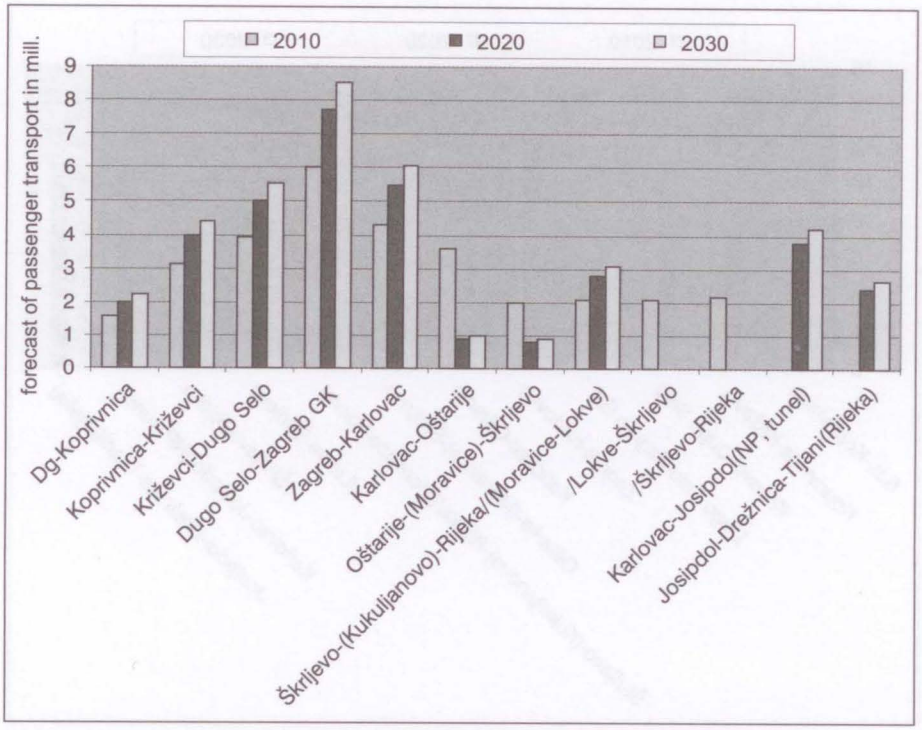

Figure 3 - Forecast of passenger transport on the pan-European Corridor V.B

cargo outside the borders of one's own country. The main advantage and benefit for the national economy lies in substantial foreign-exchange earnings, efficiency, rationalization, and optimization of transport on the main traffic routes, through improved usage of the transport capacities. It is namely the transit traffic via seaports which allows usage of the entire traffic system of a country, allowing faster accumulation of capital, and in turn of the entire economy as well.

The role of the Port of Rijeka needs to be considered in the long run as one of the most important North Adriatic ports as part of the European traffic corridors. Considered over a long term, the Croatian economy and its traffic system when Croatia becomes an EU member will be formally part of the European Union traffic system.

In the future, the European integrations will be looking for those solutions that will yield highest profit at lowest investment. This means that the ports will have to get connected and specialized in order to establish an optimal ratio of costs (investments, exploitation costs and costs of maintenance) and profits, with restrictions imposed by regulations of the European Union. Therefore, consistent plans need to be developed, the parts of which, maritime, port and those related to road, river and railway connections have to be harmonized in design and in phase realization.

The future of the development of the Port of Rijeka and the greatest part of the transit across the Croatian traffic system depends first of all on the development of the combined sea-railway or road and river traffic.

For the development of the Port of Rijeka and its international competition, it is necessary to realize gradually high-quality railway and road connections, both with North Adriatic ports (Koper, Trieste, Venice), and with Ploče, Split, Šibenik and Zadar.

As a step in stimulating an increase in traffic of general cargo containers a weekly feeder service has been formed. The service started operating in 1999. The function of feeder ships is collecting containerized cargo from minor ports to main ports that are big "transhipment" ports (such as Malta and Gioia Tauro), and accept container ships of higher capacities, the so-called Centres. The precondition for the functioning of this service is that the prices of railway and road traffic towards Rijeka are competitive compared to other North Adriatic ports, as well as the costs of transhipment and carriage. With the introduction of this service the Port of Rijeka returned at least a part of the goods from the competitive ports to the Rijeka transport route. Block container trains have been established from Rijeka to the destinations in Central and Eastern Europe: Hungary, the Czech Republic, Slovakia, Austria, Germany and Serbia and Montenegro.

The projection of the operation of the Port of Rijeka is based on the projection of traffic developed by the consultant company RMG in 2002. The projection of the traffic of the Port of Rijeka according to RMG has been presented through three scenarios (Table 6 and Figure 4): low, medium and high.

Projection of traffic in the lowest scenario represents the base projection for the other two scenarios as well,

and is based on the increase of GDP. It may be considered as the traffic projection that would be realized at the Port of Rijeka without planned investments.

Projection of traffic in the medium scenario is based on the assumption of more substantial return of traffic of traditional Central European countries on the already mentioned growth rate related to the increase of GDP.

Projection of traffic in the highest scenario is related to the increase of economy and assumption of investments into the modernization of the Port of Rijeka.

Table 6: Projection of traffic of the Port of Rijeka according to the RMG forecast RMG [t]

Variants	Year	
	2010	2020
Domestic transport	799,000	1,130,000
Transit	3,158,000	4,736,000
Low scenario	3,956,000	5,866,000
Domestic transport	1,282,000	1,841,000
Transit	3,947,000	5,889,000
Mid-scenario	5,228,000	7,730,000
Domestic transport	1,486,000	2,300,000
Transit	4,645,000	7,468,000
Highest scenario	6,130,000	9,768,000

This projection is based on the results of two big projects of the European Union [4]:

- European transport forecasts 2020 (Western Europe), DGTREN, August 1999;
- Transport forecasts on ten pan-European corridors in Helsinki (Eastern Europe), PHARE, August 1999.

The results of these studies have been proven in several East European countries and have been included in the study of the European Commission, and have been therefore used in this work as the starting basis for the projection of the traffic in the Port of Rijeka.

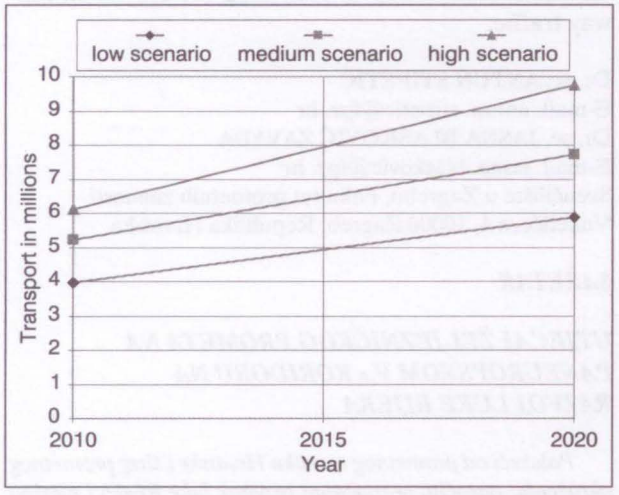

Figure 4 - Projection of traffic of the Port of Rijeka according to the RMG forecast in tonnes

Table 7 and Figure 5 provide a comparison presentation of the traffic projections of the Port of Rijeka according to the existing documentation. It is obvious that the traffic prognosis according to the "Preliminary Design of the Rijeka Junction" from 1986 with the time shift and regarding the present condition was too optimistic.

Table 7: Comparative presentation of traffic projections at the Port of Rijeka according to existing documentation in 000 [t]

Name of document	Year		
	2010	2015	2020
Preliminary Design of Rijeka Junction (1986)	26,892	30,750*	34,607
Ten-year plan of the Port of Rijeka (1998)	9,800	12,500	15,200*
Two-year plan of the Port of Rijeka (2001.2002)	6.558	8.034*	9.510*
RMG study (highest scenario)	6.130	7.969	9.768

* The values obtained by linear interpolation

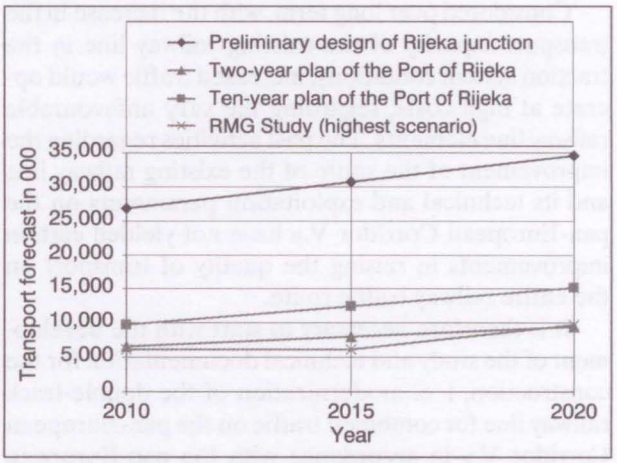

Figure 5 - Comparison presentation of traffic projections of the Port of Rijeka according to the existing documentation in 000 [t]

If all the terminals of the Port of Rijeka operated at full capacity, about 11.3 million tonnes would gravitate annually to the railways [2]. Out of these about 9.5 million tonnes would gravitate on the pan-European Corridor V.B towards Zagreb, and towards Pivka 1.8 million tonnes annually. The share of railways in the transport of the Port of Rijeka would amount to about 90 per cent.

Modernization of railway traffic route Rijeka-Zagreb-Botovo (Hungarian border) on pan-European

Corridor V.B needs to be a strong incentive to faster and better quality development of the Port of Rijeka.

The long-term vision of the development of the Port of Rijeka needs to be considered also in the context of building advanced railway connections on pan-European Corridor V.B and from Rijeka to Istria, and as part of the construction of the Adriatic railway line (Adriatic-Ionian initiative).

The analysis of the railway line on the pan-European Corridor V.B, which connects the Port of Rijeka with the continental hinterland, has indicated the need for gradual increase of capacities.

In order to span the period between the present available capacities and the realization of the design of the new level railway line Rijeka-Zagreb, the investments are required into the existing railway line for the improvement of the quality of transport.

The first phase of this operation plans a replacement of the electric traction system on the existing railway line from Moravice to Rijeka (Šapjan). The replacement of the traction system would increase the technical potential of the railway line by 20 to 40 per cent with the use of more powerful locomotives and by expanding the tracks capacities at certain stations (length of the tracks of at least 600m). The replacement of the traction system would result in an increase of the railway line transport capacity from the present ca. 6.2 to about 9.9 million net tonnes annually [5].

Considered over long term, with the increase in the transport capacity of the existing railway line in the traction system conditions, increased traffic would operate at high costs, regarding the very unfavourable railway line elements. The past activities regarding the improvement of the route of the existing railway line and its technical and exploitation parameters on the pan-European Corridor V.B have not yielded certain improvements in raising the quality of transport on the entire railway traffic route.

It is therefore necessary to start with the development of the study and technical documentation for the construction, i. e. modernization of the double-track railway line for combined traffic on the pan-European Corridor V.B in accordance with the pan-European parameters, i. e. AGC and AGTC Agreement and the Strategy of Economic Development of the Republic of Croatia. It is also necessary to orient the activities towards the harmonization of national programs for the development of the traffic infrastructure with the neighbouring countries which accommodate the pan-European corridors.

5. CONCLUSION

Since Croatia is a sea-oriented country and the Port of Rijeka represents a sea link for the transport of cargo from Central and Eastern Europe, high-quality railway connection between Rijeka and the hinterland is of extreme importance. The significance of this route is greater with the integration of Croatia into the pan-European network on Corridor V.Branch B on corridor V (Rijeka-Zagreb-Budapest) determines Croatia as a maritime country. The Port of Rijeka is the point of origin and destination of the transversal pan-European Corridor V.B. It represents the most important Croatian port for the transit of goods via the Croatian traffic system.

The Port of Rijeka generates in transit about 90% of the entire railway traffic. Austria, the Czech Republic and Slovakia and Hungary play a very important role in this traffic via the Port of Rijeka. The structure of traffic consists mostly of bulk cargo with the share of about 80 per cent of entire transit. This confirms the significance of the port and the related traffic route on pan-European Corridor V.B in performing port activities for the Central European countries.

In internal and international traffic the Rijeka-Zagreb-Botovo (Hungary) railway line is of special significance. The major part of the line on this route, especially the Rijeka-Zagreb section, passes through the hilly regions resulting in many bends and steep ascents and descents. Moreover, the existing technical condition of the railway line results in low permitted travelling speed and low technical power.

The integration of Croatia in the European railway network requires satisfaction of the basic standards planned for the European corridors, such as the realization of an average travel speed for passenger trains of about 100 km/h, and even higher in the future, and the realization of he average speed of cargo transport of about 50 km/h.

The development of the railways on the observed route is proposed through the improvements that can be realized on the existing railway line and the construction of the new railway line, as a big qualitative and quantitative step in providing the service in railway traffic.

Dr. sc. **ANTUN STIPETIĆ**
E-mail: antun. stipetic@fpz. hr
Dr. sc. **JASNA BLAŠKOVIĆ ZAVADA**
E-mail: jasna. blaskovic@fpz. hr
Sveučilište u Zagrebu, Fakultet prometnih znanosti
Vukelićeva 4, 10000 Zagreb, Republika Hrvatska

SAŽETAK

UTJECAJ ŽELJEZNIČKOG PROMETA NA PANEUROPSKOM V.B KORIDORU NA RAZVOJ LUKE RIJEKA

Polazeći od prometnog razvitka Hrvatske i šireg prometnog okruženju, naročito je značajan razvitak luke Rijeka i njezino prometno povezivanje sa zaleđem. Planirano i nužno povećanje kapaciteta luke Rijeka zahtijeva odgovarajuću podršku

željezničkog i cestovnog prometa prema unutrašnjosti Hrvatske i ostalim dijelom Europe. Pritom je naročito značajna podrška željezničkog prometa s obzirom na njezine prednosti u odnosu na cestovni promet. U radu se analizira potražnja za prijevozom robe i putnika u željezničkom prometu na paneuropskom V.B koridoru u sadašnjim i planiranim okolnostima u budućnosti. Obrađuje se prognoza prijevoza robe i putnika za razdoblje do 2020. godine u sklopu planiranog razvitka luke Rijeka. Na osnovi tog razvitka predlaže se moguće unaprjeđenje željezničkog povezivanja Rijeke s unutrašnjošću Hrvatske i istočnom Europom.

KLJUČNE RIJEČI

željeznički promet, paneuropski koridor V.B, luka Rijeka, planirani razvoj

LITERATURE

[1] *Studijska analiza postojeće dokumentacije o novoj željezničkoj pruzi Zagreb-Rijeka*, Institut prometa i veza, Zagreb, July 1995.

[2] *Studija redefiniranja prometnog i prostornog rješenja – željeznički čvor Rijeka*, ŽPD, Zagreb, 2002.

[3] *Strategija prometnog razvitka Republike Hrvats*ke, Ministarstvo pomorstva, prometa i veza RH, Zagreb, February 1999.

[4] **Hlača, B.**: *Riječka luka kao čimbenik razvitka hrvatskog prometnog sustava*, Magistarski znanstveni rad, Rijeka, 2003.

[5] **Blašković Zavada, J.**: *Model razvitka željeznice u Hrvatskoj s aspekta paneuropskog V.B koridora*, Doctoral dissertation, Zagreb, 2004.