BLAŽ BOGOVIĆ, D.Sc.
ANTUN STIPETIĆ, D.Sc.
DRAGAN BADANJAK, D.Sc.
Fakultet prometnih znanosti
Zagreb, Vukelićeva 4
Republika Hrvatska

Traffic Planning
Scientific Paper
U.D.C. 629.4.016:629.4.03:008.2(497.5)
Accepted: Mar. 2, 1999
Approved: Apr. 19, 1999

RAILWAY AS LONG-TERM INTEGRATION FACTOR OF 21ST CENTURY CROATIA AND EUROPE

ABSTRACT

The paper considers the need for constructing high-speed railway lines in Croatia that would represent a part of European high-speed railway network. The economic value of these projects is studied and highlighted, within the technological development of Croatia, with high-speed tracks as prerequisite for integration into the European exchange flows.

Considering the traffic component of Croatia, scientific research is proposed, as well as determining and defining of optimal solutions for the construction of high-speed railway tracks.

KEY WORDS

Pan-European railway corridors, high-speed trains, Croatian Railways in Europe

1. INTRODUCTION

Searching for and identifying the development strategy of a unique transportation market, the European countries have been over the last decade intensely analysing the structure of their traffic systems. Motivated by the saving of power and physical resources and the protection of the environment, the European countries are developing and constructing a traffic system on new dimensions. In land transportation system, a significant role is given to the railway due to its advantages of long-distance, and moreover, mass transportation. This provides prerequisites for a railway renaissance.

Internationally, the field of overall expansion is the construction of traffic infrastructure. There is a dense network of traffic routes developing in Europe. Primarily roads and railway lines. Sensible community uses railway traffic first of all for fast, long-distance transportation, and trucks for shorter distances.

Economically, the integration processes in Europe precede the projects of economic development. These processes will continue by expanding beyond the circle of the current European Union members. By opening big public works, and development of private entrepreneurship, Croatia sees its chance in developing industry with the aim of establishing economy which will be integrated in the European market.

Following these global considerations, the implementation consists in the need for constructing high-speed tracks in Croatia, which would be integrated in the European railway network. Therefore, the study and construction of high-efficiency and high-velocity railway tracks belongs to the government interest.

2. PAN-EUROPEAN CORRIDORS IN CROATIA

Regarding traffic position of Croatia, within the context of European traffic corridors, it may be noticed that two major Trans-European traffic routes pass through her territory.

- the longitudinal route connecting the countries of western and central Europe with the countries of south-eastern Europe and the Near East,
- the transversal route connecting the Baltic and the Adriatic Seas.

Croatia, therefore, has two basic transportation aims:

1. to establish high-quality traffic connections, mainly railway, both with the neighbouring countries and with the countries of central and south-eastern Europe;
2. to connect the Croatian Adriatic coast with the interior, including the regions of central European countries with the world traffic routes.

The mentioned aims are to be realised by developing the traffic routes on three important Pan-European traffic corridors that pass through Croatia.

The following corridors have been defined at the 3rd Pan-European Conference on Transport held in Helsinki in 1997:

5th corridor (Branch B): Budapest - Zagreb - Rijeka

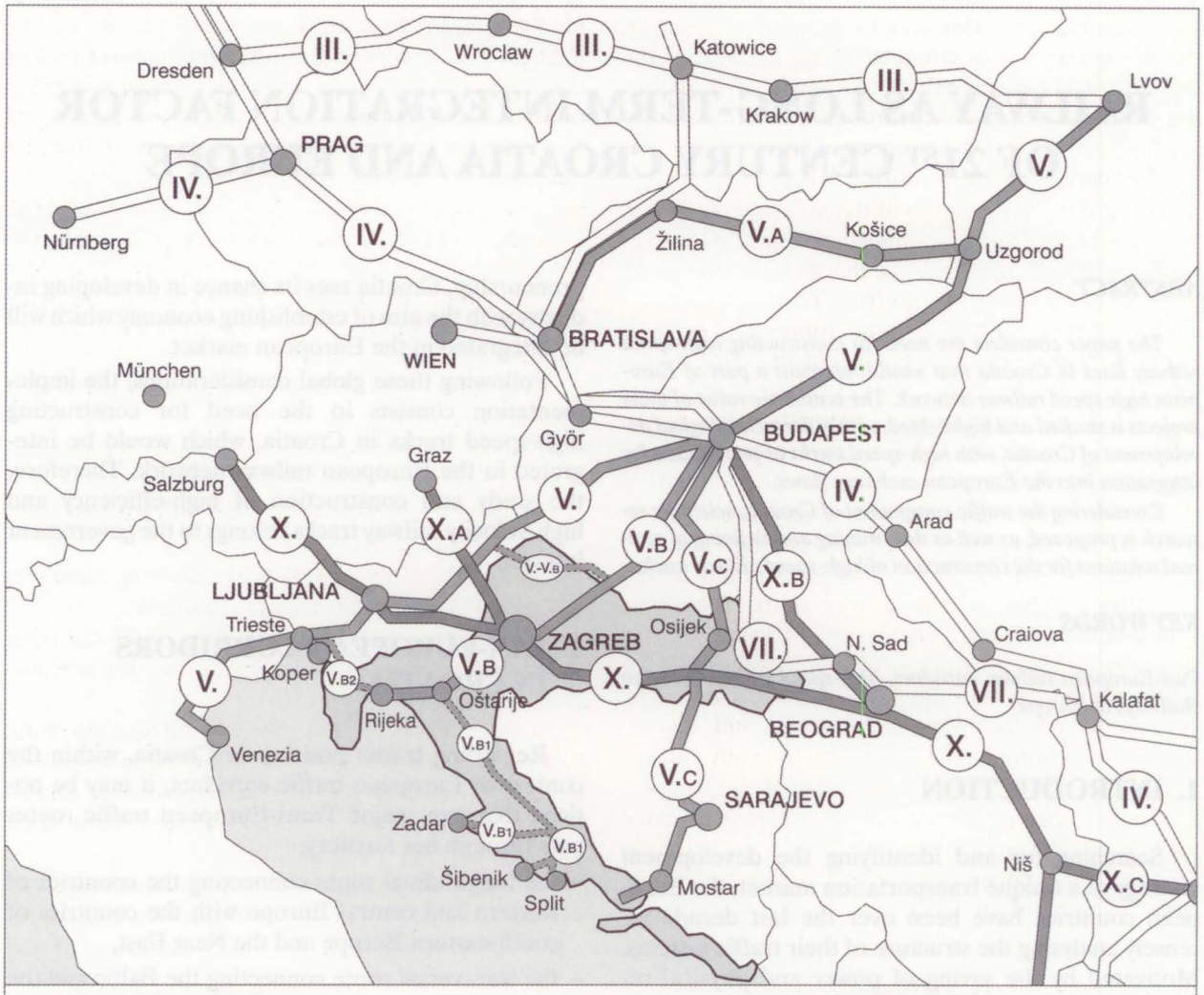
5th corridor (Branch C): Budapest - Osijek - Sarajevo - Ploče

5th corridor (connection of the main corridor and its branch B): Murakeresztur - Kotoriba - Čakovec - Pragersko

10th corridor (main): Salzburg - Ljubljana - Zagreb - Belgrade - Niš - Skopje - Veles - Thessaloniki

10th corridor (Branch A): Graz - Maribor - Zagreb

7th corridor: Danube



Pan-European Traffic Corridors
(Crete 1994. and Helsinki 1997.)

I. Helsinki-Talin-Riga-Kaunas-Warsaw

II. Berlin-Warsaw-Minsk-Moskva-Nizni Novgorod

III. Berlin-Dresden-Vroclav-Lvov-Kijev

IV. Berlin/Nürnberg-Prag-Budapest-
-Konstanca/Solun-Istanbul

VI. Gdansk-Grudziadz/Warsaw-Katovice-Žilina
(5th corridor, branch A)

VIII. Drač-Tirana-Skopje-Varna

IX. Helsinki-St. Petersburg-Moskow/Pakov-Kiev-
-Ljubaševska-Kishinev-Bucarest-Dimitrovgrad-
-Aleksandropoli
Branch A: Ljubaševska-Odessa
Branch B: Kijev-Minsk-Vilinus-Kaunas-
-Klaipeda/Kaliningrad

Pan-European corridors passing through Croatia

V.-V.B. (Gyekenyes-Murakeresztur)-Kotoriba-Čakovec-(Pragersko) connection of the 5th corridor and branches

V. Venezia-Trieste-Ljubljana-Budapest-Uzgorod-Lvov
Branch A: Bratislava-Žilina-Košice-Uzgorod
Branch B: Rijeka-Zagreb-Budapest
Branch C: Ploče-Sarajevo-Osijek-Budapest
Branch B1: (Zagreb)-Oštarije-Knin-Split/Šibenik
and Knin-Zadar
Branch B2: Rijeka-Trieste

VII. Danube corridor

X. Salzburg-Ljubljana-Zagreb-Beograd-Niš-Skopje-
-Veles-Solun
Branch A: Graz-Maribor-Zagreb
Branch B: Budapest-Novi Sad-Beograd
Branch C: Niš-Sofia towards the 4th corridor for Istanbul
Branch D: Veles-Bitola-Florina through Egnatia

Figure 1 - Pan-European corridors in Croatia

The longitudinal corridor connecting western and central Europe with the Near East is of special significance, as well as the transversal corridors connecting the Baltic and the Adriatic Seas. The longitudinal traffic route connecting central Europe with the countries of south-eastern Europe is included in the 10th Pan-European corridor and its branches. However, the transversal route connecting the Baltic and the Adriatic Sea does not belong to a single corridor, but the connection is realised through a combination of the fifth and sixth Pan-European corridors, as well as the 10th corridor (Graz - Maribor - Zagreb).

Comparing the position of the accepted corridors, a need for a quality land connection of the "snow-free traffic corridor" can be noted, that would connect the Adriatic ports, and would go from Trieste, via Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik along the Adriatic coast all the way to Albania and Greece. Today, such a connection is in the phase of study research, but it is also the topic of interstate discussions led by the representatives of the governments belonging to the Adriatic environment.

The Adriatic coast railway line may be connected to the 5th corridor (branch B) or by opening a new corridor from Trieste to Athens. The length of the railway line from Rijeka to the border with Yugoslavia amounts to 522.2 km. Due to very difficult and construction-unfriendly terrain, the construction price would amount to more than 7 billion US$, requiring detailed analysis of every single section, and international co-operation on the construction of such an important, as well as expensive railway line.

The purpose of determining corridors is to make the interested countries develop the traffic infrastructure within the corridors in order to connect with the traffic network of the EU.

3. HIGH-SPEED AND HIGH--EFFICIENCY RAILWAY LINES

Modernisation and construction of a network of high-speed railway lines has been studied and planned in Europe over a number of years. The basic aim of these plans, developed under the auspices of the European Union and International Railway Union, is to improve the railway to the level of technical and technological development of the industry, so that transport would not hinder it, but rather precede it. Thus, the European Agreement on main railway lines, Geneva, 1995, announced a network of railway lines which partly coincide with the network of corridors.

The high-speed railway network in Europe mainly encompasses the railway lines of European countries, which will form the free market. Croatia is also becoming a factor on this market, as well as a participant in the market relationships, and she will also influence the creation of market categories. This especially because the economic structure has been changed, caused by war destruction and the need for a more efficient and on natural advantages based orientation. No doubt, this applies also to the transport, i.e. transport will (apart from agriculture and tourism) cause changes and influence the economic constitution of the Republic of Croatia. The role of railway is indispensable here. It refers especially to the defining of the Croatian high-speed railway lines for connecting her economy with Europe.

The attempt of Croatia to get integrated into the high-speed railway network lies in accepting the traffic development strategy of Croatia[1]. Therefore, the main strategic development guidelines for the Croatian railways is the participation in the European integrations.

In order to achieve this, it is necessary to develop the infrastructure which would:

- satisfy the European service standards, both in traffic organisation and computerisation,
- satisfy the technical and transport infrastructure parameters in the accepted corridors,
- upgrade the quality of services and bring them to a similar level as the European standards,
- improve the legislative regulations of the Croatian Railways according to the legislation of the European Union.

Moreover, in order to enable the integration of the Croatian railways into the transportation system of the 21st century Europe, it is necessary to make a number of organisational modifications at the railway such as:

- separation of the infrastructure from the transport,
- providing equal conditions of accessing railway infrastructure for all the potential carriers at all the sections of the European network, including Croatia,
- integration of railways with comparative systems (road, air, and water transport) in order to achieve better quality services.

High speed regarding railway transport is considered to be the train speed of 200 and more kilometres per hour. The top speed on mixed-transportation lines (passenger and cargo) is planned up to 250 km/h.

Today, the basic high-speed railway network has been constructed, and this is planned to be supplemented by a network of connecting lines. The existing high-speed railway lines are being supplemented and an extension of the network towards the countries of central and eastern Europe is being planned.

Experience show that the construction of high--speed railway lines is a very expensive venture (depending on the terrain conditions the prices range from 3 to 10 million US$ per kilometre). The

break-even point of such a line is transport of five and more million passengers annually.

For speed of over 200 km/h, as a rule, new tracks need to be constructed, because reconstruction of the existing tracks is almost impossible due to the need for great corrections of the track geometry, and thus also great deviations from the existing route. Therefore, Croatia does not plan complete construction of high-speed tracks in the period until 2020, but starts to realise it in phases, by constructing single-track and double-track sections (providing speeds in the first phase of exploitation ranging from 160 to 200 km/h). The introduction of trains with a gradient technique would span the gap between the today's condition of the tracks and the future high-speed tracks (since the gradient technique does

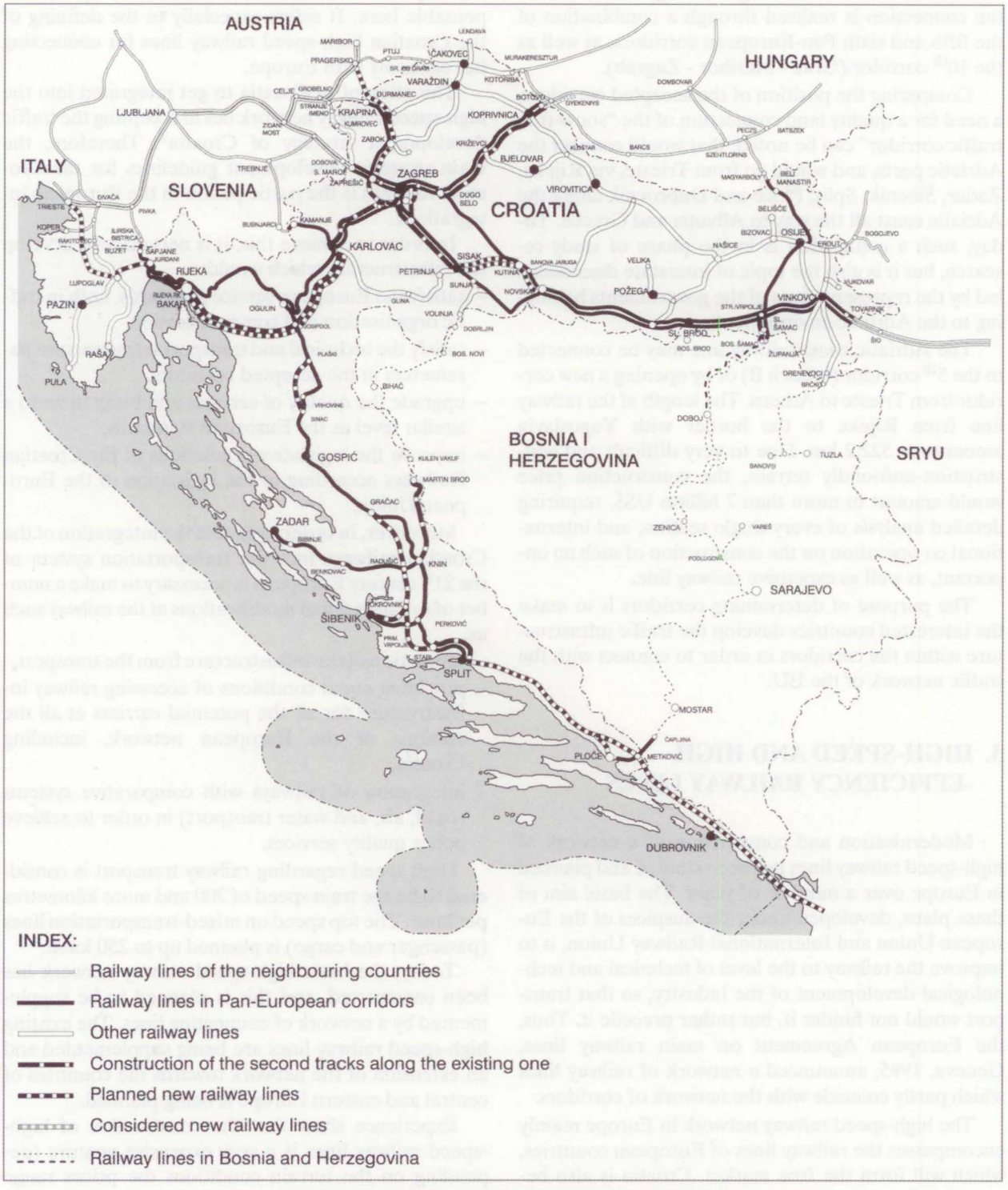


Figure 2 - Priorities of the railway phase construction in Croatia

not negate the needs for constructing high-speed railway lines).

These are the reasons for forming the basic contour of the high-efficiency railway network, which can later become part of the high-speed railway network.

Today, Croatia is giving priority to the development of railway network (Figure 2) in the accepted corridors:

In the 5th corridor (branch B) from Budapest to Rijeka the most part of the existing railway line (from the state border to Moravice or 72.6% of the total route, in the length of 328.5 km) is level line. 27.4% of the tracks have unfavourable transport characteristics, and a greater investment on this section could improve the exploitation conditions.

Final verification of its traffic - geographic characteristics can be obtained by the construction of a new double-track level line (with maximum speed between 200 and 250 km/h), which shortens the connection between the Danube region and the Adriatic by 80 km, increasing the capacity ten times. Until now, two possible versions of the railway line have been presented. One, that passes along the valley of the Kupa river ("Kupska") and nears the sea at Hill 200 through a 25 km long tunnel. The other route ("Drežnička") passes along the valley of the Korana river, and breaks through the massif of Velika and Mala Kapela by tunnels 9.2 and 13.6 km long, reaching the Adriatic coast. Regarding the route length and the technical characteristics, the first one is preferred, whereas the second one is financially more profitable by about 500 million US$ due to high costs of constructing the 25 km long tunnel Risnjak.

The development plans of improving the railway line capacity, depend greatly on the volume of transport through the Rijeka harbour. The cargo handling capacities amount today over 7 million tons, but in the future they may increase to over 30 million tons. The travelling time from Rijeka to the border with Hungary takes today about 5 hours. The construction of the new level line from Karlovac to Rijeka, with the construction of the second tracks along the existing line from the Hungarian border to Karlovac, would reduce the travelling time from the border to Rijeka to less than two hours.

Considering the logical extension of this railway line from Rijeka towards Trieste (in the length of 30 km), the fifth corridor might be connected to the international route Barcelona - Trieste - Zagreb - Budapest - Kijev.

A railway line of such characteristics with the Rijeka harbour (and the ports of Koper and Trieste), can offer high-level services and meet various needs of central and eastern Europe.

In the 10th corridor passing in the length of 329.0 km through Croatia, there is a double-track line in the length of 232.4 km. In the middle part from Dugo Selo to Novska (in the length of 84.1 km) and Zagreb via Sisak to Novska (in the length of 117.4 km), there are two single-track lines. Today, this railway line provides speed of 140 - 160 km/h.

The construction of a new double-track railway line from Sisak to Kutina (32.4 km long) and adding of the second track from Kutina to Novska (in the length of 23.3 km), and from Zagreb to Sisak (in the length of 50.0 km) would provide a double-track line and constant speed along the whole route through Croatia.

4. EFFECTS OF RAILWAY DEVELOPMENT

The study of influencing parameters indicates that there are potentials and chances for efficient integration of Croatia in the European high-speed railway network. High-speed tracks are multiply useful, for shortening the travelling time, increasing the technical performance, and especially because of adjusting to the European network since this is also the precondition of connecting the economies of Croatia with Europe, and the integration of the European market is possible by the construction of high-speed railway network.

The effects would be achieved based on winning greater import-export and transit traffic, which would generate new quality of transport services. Significant economic, energetic, spatial, ecological, safety and other aspects refer to the advantages of railway. In Europe, these aspects are being constantly studied and approved of, and there is mention of the railway renaissance. Of course, the one with a higher technical structure: high speeds, better organisation, and marketing approach.

Modernisation and construction of high-speed tracks is a complex development program which implies also the modernisation of all the system elements, infrastructure, means of transport, and integral transport. This will be reflected as a motivating activity on several industrial fields, such as civil and mechanical engineering, power industry, etc. Besides, the construction and modernisation also mean new employment, improvement of tourism, and increase in the tourist demand. The development of tourism on the other hand, initiates a number of other activities, from catering and trade to servicing activities.

5. CONCLUDING REMARKS

The considered topic may be summarised in several statements, conclusions and proposals.

High-speed tracks will attract new transportation flows, especially those from the harbour im-

port-export and transit transport. Since these routes will serve long-distance transport, they will re-direct the passenger and cargo flows from almost half of Europe and thus establish a natural connection in this region. For Croatia, these railway lines will mean fastest communication on its whole territory. At the same time, this will initiate high transport efficiency, because of the high-speed railway network in the country. In these conditions, two main corridors in Croatia will acquire international significance in its full sense, since they would be treated from the European aspect, as part of the high-speed railway network.

High-speed track projects in Croatia would find their efficiency in the international and national environment.

From the international aspect of forming the European high-speed railway network, the railway competitiveness would be increased, and after the construction of the Vukovar - Šamac canal, the sea and river navigation systems in the south-eastern part of Europe would become connected.

National significance would be achieved by establishing a more natural connection of Croatia with the European territory that gravitates towards the considered corridors, substantial increase of railway traffic productivity in Croatia, and providing the possibility of integrating the Croatian economy with the European.

The considered topic of the two main Croatian corridors has only conceptual meaning. All the rest more concretely requires qualitative scientific research in order to realise such capital investment activities. Therefore, science needs to be engaged, in order to study multiply the mentioned issues, and to find and define optimal solutions, design, mark out, and plan the phases of constructing railway objects.

LITERATURE

[1] **Božičević, J., Badanjak, D., Stipetić, A.** et al: *Prijedlog strategije prometnog razvitka Republike Hrvatske*, Institut prometa i veza, Zagreb, 1998

[2] **Stipetić,A., Mlinarić, T.**: *Visobrzinska pruga Rijeka - Zagreb - Koprivnica*, Proceedings "Prometna valorizacija Hrvatske u funkciji europskih i svjetskih tokova", Promet 4 (1992), Supplement to No. 1, pp. 79-84

[3] **Stipetić, A.**: *Pruga velikih brzina Zagreb-Krapina-Pragersko (Beč)*, Proceedings "Prometna valorizacija Hrvatske u funkciji europskih i svjetskih tokova", Promet 4 (1992), Supplement to No. 1, pp 123-133

[4] **Stipetić, A., Božičević, D.**: *Die Eisenbahnlinie Ljubljana/Maribor, zidani Most (Staatsgrenze)-Zagreb-Vinkovci(Staatsgrenze)-Beograd-Sofija-Istambul-Athen*, Österriechische Ingenieur und Architekten, 142 (1997, No. 2, pp. 120-125

[5] **Kreč,S., Stipetić, A.**: *Die Eisenbahnlinie Maribor - Pragersko - (Staatsgrenze) - Zagreb - Split/Šibenikl, Zadar*, Österreichische Ingenieur und Architekten, 142 (1997 No. 2, pp. 125-132

[6] **Božičević, J., Kreč, S.**: *Prometno povezivanje srednje Europe s Jadranom*, Proceedings of the Symposium "Integration of Central European countries with the Adriatic (Mediterranean)", Zagreb, 1998, pp. 151-171