



POSSIBILITIES OF RAILWAY CONNECTION BETWEEN RIJEKA AND TRIESTE WITHIN THE EUROPEAN TEN-T NETWORK

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Abstract

In the existing railway network of the Republic of Croatia there is no direct connection between Rijeka and Trieste via Istria. It is theoretically possible to achieve this indirectly through several railway lines crossing Slovenia. As a result, our largest peninsula of Istria has remained completely isolated from the rest of the country from the point of view of rail transport. Trieste-Rijeka section is not included in the Mediterranean corridor, that is, in the basic TEN-T network. Some research [1], [2], [5] and facts show that there are numerous reasons for the construction of a new modern railway line between Rijeka and Trieste, which could be of great importance in the transport, technological and economic system of the Republic of Croatia and the European Union. The new concept of railway connection between Rijeka and Trieste envisages the construction of a new high-efficiency two-lane railway across the territory of Istria and partly across the territory of the Republic of Slovenia. In fact, the construction of a new railway line is foreseen on the Rijeka - Jurdani - Divača route, while the Divača - Trieste section is foreseen for reconstruction and modernization within the investment program of the Mediterranean Corridor. According to above research, this connection can be achieved in two ways: according to the first, the connection can be achieved by upgrading and modernizing existing lines on the route Jurdani - Pivka - Divača, and the second, by constructing a new line on the route Jurdani - Lupoglav - Divača. This second method of connection has the advantage in that it directly connects the Istrian railways into a complete system of Croatian railways.

Keywords:

1 Introduction

In the existing railway network of the Republic of Croatia, there is no direct connection between Rijeka and Trieste via Istria. Theoretically, it is possible to achieve it indirectly through several railways corridors that cross the territory of Slovenia. Thus, our largest peninsula, Istria, from the point of view of railway traffic, remained completely isolated from the rest of the country.

The Primorje-Gorski Kotar County, in partnership with a number of public bodies led by the Friuli Venezia Giulia Region of Italy, was involved in the “ADB Multiplatform” project, a cross-border project with the full name “Adriatic-Danube-Black Sea multimodal platform”.

The intention of the project [3], was to develop and promote environmentally friendly, multimodal transport solutions from ports in the program area of Southeast Europe (Black Sea, Aegean, Adriatic) to inland countries and regions along the selected pilot transnational network. This will be achieved through the development and establishment of a multimodal transport development platform that integrates different regions and stakeholders from the transport industry. As part of this project [3], a study was conducted and a study of framework options for connecting the northern Adriatic port system by high-efficiency railway [2], as a platform for undertaking appropriate activities at EU and Croatian level to include a new line in the Mediterranean Corridor, and thus in the basic TEN-T network. EU, and in the ADB multiplatform concept which outlines the efficient connection of the northern Adriatic ports with the Danube and the Black Sea.

It should be noted that the proposed network concept fits in and does not undermine the importance of the project of a new railway from Rijeka to Zagreb and further to Hungary. In this research in the context of studies [3], special emphasis was placed on the exceptional need for this project as a complete solution of the railway transport network in Croatia.

2 About the project

There is no direct connection between Rijeka and Trieste in the existing railway network. Theoretically, it is possible to achieve it through several railways that cross the territories of Croatia, Slovenia and Italy. These are the railways: Rijeka-Šapjane DG-Ilirska Bistrica-Pivka, then the railway Pivka-Divača-Sežana and finally Sežana-Trieste. Existing railways have very unfavorable technical and technological parameters:

- across Divača and Pivka railway it is 122 km long, which is almost 25 % more than the planned new railway (80 km)
- almost all lines have a maximum allowed longitudinal slope of 25 mm/m
- the maximum speed on the mentioned lines is 60/80 km/h

It follows from the above that the existing lines are not favorable for the establishment of direct railway traffic Rijeka-Trieste, so they do not run any direct train between these destinations.

2.1 New European policy for transport infrastructure TEN-T

The global concept of the core network is based on the fact that transport is crucial for the efficiency of the European economy. Without good transport links, the European economy will not be able to grow and develop. As a means of boosting growth and competitiveness, a strong European transport network is being set up under the new EU infrastructure policy, covering 27 Member States. It will be a true European network that will connect East and West and thus eliminate the current traffic fragmentation of Europe.

The new infrastructure policy is tripling the EU's transport budget. At the same time, the focus of transport financing is shifting to a clearly defined new core network. The core network will be the mainstay of the European single market. It will remove bottlenecks, modernize infrastructure and increase the flow of cross-border traffic. As a first step in establishing this network, nine main transport corridors have been set up, connecting Member States and allowing them to pool their resources to achieve better results.

The new core TEN-T network will be supported by a comprehensive network of traffic routes that will flow into it at regional and national level. The goal is to gradually ensure, by 2050, that the vast majority of European citizens and businesses are no more than 30 minutes away from this comprehensive network.



Figure 1 TEN-T core network corridors

Furthermore, by 2050, freight traffic is expected to increase by 80 % and passenger traffic by more than 50 %. Adequate trade is needed for growth, and it is not possible without turnover. European areas that are not well connected will not be able to develop as planned. The lack of links, especially on cross-border sections, is a major obstacle to the free movement of goods and passengers within and between Member States, but also towards neighboring non-EU countries. There is a large gap in the quality and availability of infrastructure between Member States, and often within them. Improvements are particularly needed on East-West connections, which can be achieved by building new transport infrastructure and / or maintaining, renovating or modernizing existing ones.

The transport infrastructure necessary to connect the various modes of transport is also incomplete. Many European freight and passenger terminals, land and sea ports, airports and city hubs are not up to the task. Due to the weak multimodal connectivity in these hubs, the possibilities of combined transport, which could solve the problem of bottlenecks and the lack of connections, are underused. Investment in transport infrastructure should contribute to the 60 % target of reducing greenhouse gas emissions in transport by 2050. Member States still have different operational rules and requirements, especially in the area of interoperability, which further increase infrastructure barriers and bottlenecks.

A major novelty of the new TEN-T guidelines is the introduction of nine corridors that make up the core network. Each corridor must cover three modes of transport, three Member States and two cross-border sections. Corridors that stretch in area and are important for Croatia are the Mediterranean and Rhine-Danube corridors. Within the new TEN-T network, the importance of the Mediterranean corridor was especially emphasized, which is extremely important for Croatia and for the project of the planned new Rijeka-Trieste railway. It connects the Iberian Peninsula with the Hungarian-Ukrainian border, follows the Mediterranean coast of Spain and France, passes the Alps where it turns to the east and north of Italy, from where it crosses the Adriatic coast of Slovenia and Croatia to Hungary. It can be seen from the above that the planned new Rijeka-Trieste railway is an integral and unavoidable part of this corridor.

2.2 Objectives of the planned project

The main goals of this project would be:

- development of a network of multimodal hubs in the southeast area with common quality and performance standards related to innovative IT and transport services
- development of accessibility and trade within Southeast Europe and the mentioned corridors
- multimode development transport as a real alternative to inland roads but also the inclusion of Adriatic / Aegean / Black Sea ports through joint activities for the development of multimodal transport
- development of the railway as a reliable solution for economic entities in the southeastern area, through the development of a railway corridor connecting the Black Sea with the mainland countries, with branches towards the main ports on the Adriatic;
- integration of rail and river transport through the strengthening of major rail and river hubs and the promotion of intermodality on the rail-inland waterway route;
- environmental protection in the area of Southeast Europe through the change of modalities of transport from roads to railways and inland navigation, the development of international agreements for the development of regulations for the internalization of external costs.

2.3 Railway development opportunities in the Republic of Croatia

The railway system in Croatia has organizationally adapted to the railway system in the EU. Now follows the harmonization of the elements of railway infrastructure in Croatia with that in the EU. In order to create a single railway area in the EU and liberalize access to railway infrastructure, the railway system in the EU countries (and candidate countries for EU accession) has been divided into infrastructure and carriers. Infrastructure has been declared a public good and the care for the maintenance and development of railway infrastructure has been taken over by the state.

As independent economic entities on the railway services market, railway undertakings equally impose themselves in the provision of railway services, and take care of their operations and development plans. Regulatory bodies established in the Member States should provide unhindered and non-discriminatory access to railway infrastructure for railway undertakings.

The EU transport system is giving increasing importance to transport branches that have a less negative impact on the environment, and contribute to the overall efficiency of the transport system and the reduction of total transport costs. Preference is given to combined and intermodal transport, with an incentive to develop water (inland waterways and maritime transport) and rail transport. Croatia has all these components of the transport system, so we can expect more generous support for their development as part of the development of the entire EU transport infrastructure.

In addition to the construction of a new high-efficiency railway Rijeka-Zagreb, one of the primary directions for the development of transport infrastructure in the Primorje-Gorski Kotar County is to consider the development of high-efficiency railway infrastructure on the Rijeka-Trieste route. Apart from being the backbone of the North Adriatic transport route, which is the shortest and most economical route to the Mediterranean and further to Asian countries, this transport route will be the starting point for further connecting the transport infrastructure on the Adriatic-Ionian transport route whose main task is transport and economic integration. countries along the corridor (Italy, Slovenia, Bosnia and Herzegovina, Montenegro, Albania, Macedonia and Greece).

In the case of the port of Rijeka, connecting to Trieste by rail would be vital for integrating regional and urban economy and competitiveness. Namely, such a connection would open the door for Croatia to the whole of Italy and further through the railway freight corridor 6 (RFC 6) to EU countries, which would greatly contribute to the overall regional development, and this cannot be achieved through the existing railway.

With this new line, Istrian lines could be connected to the Croatian railway network within the territory of the Republic of Croatia, which would mean a strong economic rise induced by a quality railway network directly for the Istrian county.

The construction of a new high-efficiency railway Rijeka-Zagreb and a new railway Rijeka-Trieste will shorten the connection between Southeast Europe with its central and western part, which will increase the exploitation of transport infrastructure in the Republic of Croatia, which will lead to job creation, creating economic growth and increasing government revenue.

It is to be expected that this railway will greatly stimulate economic activities in the area through which it passes. According to the Transport Development Strategy of the Republic of Croatia, specific objective 5b states the need to improve accessibility in freight transport - North Adriatic (Rijeka), according to which the commitment is that the railway line between Trieste and Rijeka gained better and safer access to the Danube corridor and further east to the Black Sea, and would import the Adriatic-Ionian initiative into the system.

3 Variant solutions for the new railway from Rijeka to Trieste

Three possible variant solutions for the railway connection between Rijeka and Trieste were considered. An analysis of traffic demand was made, an analysis of the financial and economic aspects of the new railway. By multi-criteria analysis of the proposed corridors, a preferred solution was nominated.

Variant solutions were considered the possibility of connecting to the railway network of Italian railways, and previously by connecting to Slovenian railways, in order to analyze the possibility of connecting with the ports of Koper and Trieste.

Variant solutions were also considered the possibility of connecting to the existing and planned transport (railway) network in Croatia, Slovenia and Italy in accordance with national development plans as well as EU development plans. The railway was planned as a two-track, and in the economic evaluation the cost-effectiveness of the two-track was examined with regard to the traffic forecast, ie the phasing in the realization of the two-track.

3.1 Project solutions

The boundary elements of the open line route (floor and height elements) are determined for a conventional line with a design speed:

- $V_{max} = 160 \text{ km / h.}$
- $V_{freight} = 100 \text{ km / h.}$

In the area of Primorje-Gorski Kotar County and the corridor from Jurdani to Pivka, two basic variants were analyzed:

- V1: new railway route with a detour of Šapjane and Ilirska Bistrica with a connection to the Ljubljana - Divača railway in Pivka,
- V1A: a variant that goes around the settlements north of Jurdani (in this context a larger tunnel appears), uses part of the existing line (with the necessary geometry corrections) and ends the same at the Pivka station. In terms of “environmental protection”, there are basically no significant differences between variant V1, but it is less investment-friendly.

In the Istrian County, 5 variants were analyzed in principle, primarily due to finding a possible connection of Istrian railways to the new route, and the connection of the new route to Slovenian railways, whether on the line Koper - Divača or directly in Divača.

Namely, the configuration of the terrain and protected areas in Istria are extremely complex. In addition, HŽI made the decision to abandon the Učka tunnel, so the connection of the Istrian railways became even more complex. In such circumstances, the only possibility was the connection between Judani and Istria by a tunnel through Čičarija, and only so that the tunnel exits in front of the Lupoglav station. In that way, the station would remain in function and new railways (with renovation), which would enable the connection of the existing railways for Pula, Raša and Buzet to the new railway. With a minor deviation of the existing line to Pula in the station zone, direct rides from Rijeka to Pula and vice versa are provided. The route of the existing railway for Buzet and Raša remains as it is, and the connection to the new railway is provided at the Lupoglav station. The following variants of the route were considered in Istria:

- V2: new route of the railway from Jurdan through the Čičarija tunnel to the Lupoglav station, and further a new route in the wider corridor of the existing railway (elements of the railway for 160 km/h) towards Divača,
- V2A: a new route from Jurdan through the Čičarija tunnel, but the exit from the tunnel does not allow a connection with the Lupoglav station, but the route would remain on the plateau above the station, which would result in one tunnel less than in V2. In the continuation, the new route is in the wider corridor of the existing railway (elements of the railway for 160 km/h) towards Divača,
- V3: new route of the railway from Jurdani through the Čičarija tunnel to the Lupoglav station, and further a new route (elements of the railway for 160 km/h) towards the connection to the railway Divača - Koper near Črni Kal. Technically extremely complex and demanding route considering the relief and population,
- V3A, V3B: subvariants of variant V3 in the part from Lupoglav to Črni Kal, primarily trying to overcome the complex relief in the wider surroundings of Buzet.

In the group of variants 3, there would be a particularly technically complex connection of the railway to the Divača - Koper railway (with a large viaduct that should be connected to the Črni kal viaduct on the Divača - Koper railway). The connection of the viaduct to the viaduct cannot be avoided, because before and after the Črni Kal viaduct there are tunnels, which makes this connection even more difficult. Very demanding technical solutions and connection conditions (on the open line, without the station) cause exceptional costs and put the group of variants 3 in a less favorable position than the other groups of variants.

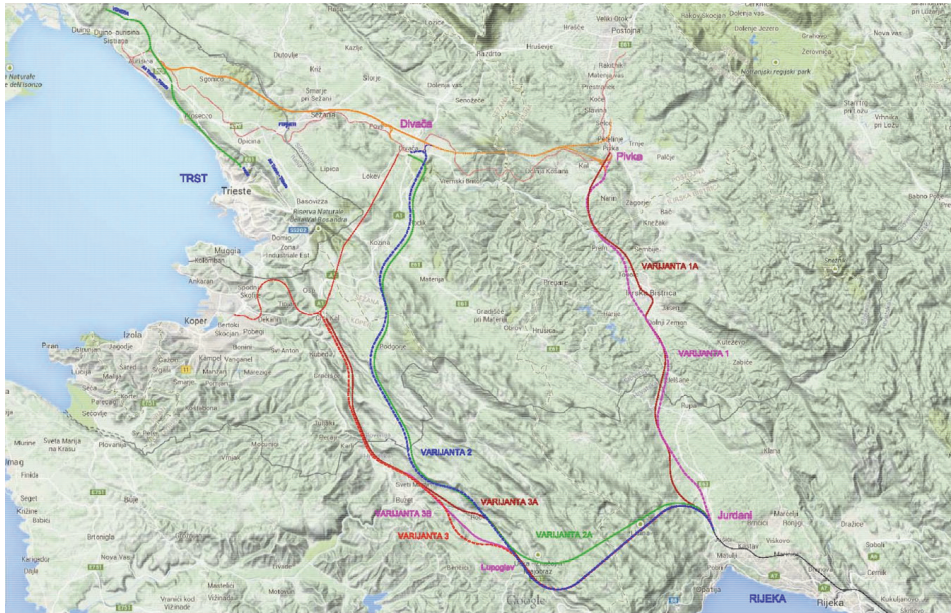


Figure 2 Spatial position of the investigated corridors with variants of the Rijeka - Trieste railway

Based on the elimination criteria and expert assessment, of the analyzed variants for further analysis, three were proposed: V1, V2 and V3.

- Variant 1: Jurdani station - Pivka - Divača station;
- Variant 2: Jurdani station - Divača station;
- Variant 3: Jurdani station - connection to the new railway Koper - Divača

In order for the variants to be analyzed and properly valorized, they always started in the same station (Jurdani station). The lengths of the sections in question, measured from the middle of the Jurdani station to the middle of the Divača station (in Slovenia), as the end points of all variants, are:

- according to Variant 1: 51,688 km
(Rijeka - Pivka 35,857 km Pivka - Divača 15.83 km)
- according to Variant 2: 66,630 km
(Rijeka - Lupoglav 20.00 km, Lupoglav - Divača 46.63 km)
- according to Variant 3: 66,980 km
(Rijeka - Lupoglav - Črni kal 50.98, Črni kal - Divača 16.00 km)

From the Divača station, the reconstruction is planned, ie the construction of a new two-track railway to Trieste and to Ljubljana. In these analyzes, these corridors were taken over, and new routes from Rijeka were planned so that a connection to this planned line would be established. The combination of the selected variant from Rijeka to Divača and further with a new connection to Trieste (Aurissina) and Koper, ensures the interconnection of the ports of Rijeka, Trieste and Koper, ie their connection to the 6th freight corridor TEN-T network (via the newly planned line Trieste - Aurissina - Palmanova - Venice).



Figure 3 Newly planned corridor (blue) Divača - Sežana - Aurissima (connection to the Trieste - Venice railway) (green)

The total length of the route according to variant V1 is 35,857.19 km, of which 13 km of the route is in the territory of the Republic of Croatia and the remaining 22 km of the route is in the territory of the Republic of Slovenia. In variant V1, the total length of bridges and viaducts is 6.56 km, and tunnels 28.91 km (the share of buildings is 55.15 % of the section length). Longitudinal slopes range from 1-12 mm/m.

The total length of the route according to variant V 2 is 64,320 km, of which 35.4 km of the route is in the territory of the Republic of Croatia and the remaining 28.92 km of the route is in the territory of the Republic of Slovenia. In variant V2, the total length of bridges and viaducts is 11.55 km, and tunnels 7.74 km (the share of buildings is 53.82 % of the section length). The longest tunnel is Čičarija, 15.57 km. Longitudinal slopes range from 3-12 mm/m.

The total length of the route according to variant V3 is 50,329 km, of which 38.5 km of the route is in the territory of the Republic of Croatia and the remaining 11.8 km of the route is in the territory of the Republic of Slovenia. In variant V3, the total length of bridges and viaducts is 16.19 km, and tunnels 20.16 km (the share of buildings is 72.13 % of the section length). The longest tunnel is Čičarija, 15.57 km. Longitudinal slopes range from 0-10 mm/m.

Variant 3 (as well as variant 2) has the advantage of connecting Istrian railways into a complete system of Croatian railways, but it is extremely technically and technologically complex. The route from Lupoglav to the connection to the planned railway Divača - Koper is especially complex, where a number of very complex viaducts appear. The realization of the project is planned in stages through three stages:

- Stage 1: renovation and modernization of the existing railway for a speed of at least 80 km/h,
- Stage 2: construction of one track of a new two-track railway for a speed of 160 km/h,
- Stage 3: construction of the second track of the new two-track railway with the completion of all necessary works.

In the study [1], a multi-criteria evaluation of variant solutions was performed by the method of Promethee I and II and GAIA (Geometrical Analysis for Interactive Aid) according to the group of input parameters: economic, traffic, technical-technological, urban-planning and ecological-social, in principle with 4 sub-criteria in each group, on the basis of which the input matrix was created. Additional evaluation was performed using the AHP (Analytic Hierarchy Process) method.

Based on the conducted evaluation and CBA analysis, it can be concluded that the construction of a high-efficiency railway: Rijeka - Trieste is fully socio-economically justified in the case of stage 1 (variant V1) - modernization of the existing railway and stage 2 - construction of a new single-track railway. Realization of stage 3 - upgrading of the second track does not represent a socio-economically justified investment. Comparing all variants, variant V1 from the perspective of defined criteria produces the best socio-economic results.

It should be emphasized that all analyzed variants show a high level of socio-economic justification and as such are suitable for implementation. Variants V2 and V3 are provided through the area of Istria and the realization of one of these two variants contributes to the socio-economic development of the Istrian peninsula due to better access to modern railway infrastructure, especially considering the fact that the railway in the corridor will be built on the section Jurdani - Lupoglav (Črni kal) which does not exist today, or be modernized on the stretch Lupoglav - Divača.

All analyzes and forecasts, as well as technical solutions and variants of the high-efficiency railway presented in the research [1], represent an assessment of the framework possibilities of connecting the North Adriatic ports by railway from the current perspective of the possibility of its realization. The economic justification confirmed by the conducted analysis is expected to be higher in case the project implementation deadlines are moved to future periods; provided that no decline in railway demand is expected in the future compared to the forecast and the view that there will be no significant decline in GDP and other macroeconomic indicators in the project area.

The project “Multimodal Platform Adriatic-Danube-Black Sea”, an integral part of which was the research of possible connections of northern Adriatic ports, included significant stakeholders from the Republic of Croatia. The holder of part of the activity was the County of Primorje-Gorski Kotar. With the cooperation of the Port of Rijeka Authority, the Intermodal Transport Cluster and with the support of HŽ Infrastruktura, further long-term and medium-term development potentials of this area are being integrally considered. This approach of joint development considerations of all entities in the transport chain certainly ensures the assumption of dynamic and sustainable development and thus the only possible basis for ensuring the emphasis on comparative advantages but also a credible positioning within the entire transport corridor.

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