INVESTMENT IN THE CONSTRUCTION OF THE SECOND BORE OF THE UČKA TUNNEL

Research Paper

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Abstract

Investing in the construction of the second bore of the Učka tunnel has significantly more positive effects and benefits compared to the financial costs of the project.

The paper analyzes the main benefits of the project through several determinants such as: level of user safety, shortening of travel / waiting time, environmental protection, development of a comprehensive trans-European road network (TEN-T) and positive impacts on the local community and national economy. The additional level of user safety that should be achieved was considered through the number of accidents and accident costs per person, the safety of the Učka tunnel and the safety and productivity of infrastructure maintenance workers. The safety analysis of the Učka tunnel was based on the European Commission Directive no. 2004/54 / EC on minimum safety requirements for tunnels in the TEN-T network. Travel and waiting time shortening factors were analyzed according to the time dimension value and the value of each additional hour spent on the trip. Impacts on environmental protection are especially related to the topics of the closed drainage system, water protection and animal protection. The positive impacts of the project in terms of the European Union have been observed through the upgrade of the comprehensive trans-European road network (TEN-T). The impact on the economy as a whole was observed through the potential of opening economic zones and business areas and the impact on improving the employment of people from the local community and the obvious positive impact on tourism.

*Keywords **:** Bina-Istra d.d., Učka Tunnel, Directive 2004/54 / EC, Istria, Istrian Y, motorway, economy, tourism, GDP, safety*

INTRODUCTION

The assessment of the feasibility of an infrastructure project does not depend only on the immediate cost of building one such project and the possible annual return through usage charges. In order to determine the justification of a large infrastructure project, it is necessary to look at the bigger picture and as many spheres of influence as possible. The construction of a large infrastructure project, such as the addition to the full profile of the Učka tunnel - the construction of a new tunnel bore, has its impact primarily on the traffic factors of the area under construction - Istria and Primorje-Gorski Kotar Counties. For the growth and development of the Istrian region, including these Counties, a modern and well-developed and branched transport infrastructure is necessary, and the existing bore of the Učka tunnel in this regard is a very important link and a lifeline, but also a sensitive point and bottleneck. At one time, the importance of building the existing tunnel bore led to a stronger connection of Istria with the rest of Croatia, which had, in addition to traffic, and great economic and political importance. The construction of such a project significantly changes the duration of travel on the section due to higher speed, also contributes to traffic safety by separating traffic flows, affects local migration, changes the transit of people and goods, opens new opportunities in passenger and freight transport. In addition to the immediately obvious and long-term transport effect of the project, its construction would lead to short-term and long-term changes in the economy, both locally and nationally through the consequent effects on GDP due to the involvement of local companies and workers in such a project. , as well as contributing to the further growth and development of tourism as the primary economic activity in the area where the project is being built. The consequences for the economy that would be reflected in the tourism sector are reduced to greater and better throughput and accessibility, as well as the opening of opportunities for the transit of more tourists and domestic guests to the final tourist destinations in Istria. This is justified by the fact that, according to statistics, over 95% of tourists come to Istria by road.

In addition to the listed positive effects of the construction of this type of infrastructure project, it is clear from previous experiences that they do not lead to the generation of sufficient revenues to finance the construction of such projects. There is a significant impact of the seasonality of traffic, ie high levels of traffic in summer and early autumn, while in winter there

is a noticeably lower intensity of traffic. In periods of high traffic, a high share of tourists in the number of infrastructure users is noticeable, while infrastructure in quieter periods with lower traffic intensity is primarily used by the local population. Furthermore, although it is located on a comprehensive TEN-T network, this section of the motorway is not as transit as sections in neighbouring countries, such as Slovenia and Austria (eg the Karavanke tunnel). This structure of traffic results in the fact that the amount of tolls collected is not sufficient to cover all costs of financing the construction of the project as well as the costs of management and maintenance incurred by the concessionaire, in this case, the concessionaire of the Istrian Y.

The main aim and subject of this paper is to investigate and prove how the construction of the second bore of the Učka tunnel affects much more than the obvious improvement of Istria's transport connections with the rest of Croatia and that it is not enough to consider only financial profitability

When building such a demanding infrastructure project, it is necessary to consider the synergy of positive macroeconomic and microeconomic effects in order to decide on the justification of investment in the construction of the second bore of the Učka tunnel.

1 INFLUENCE OF CONSTRUCTION OF THE SECOND BORE OF THE UČKA TUNNEL

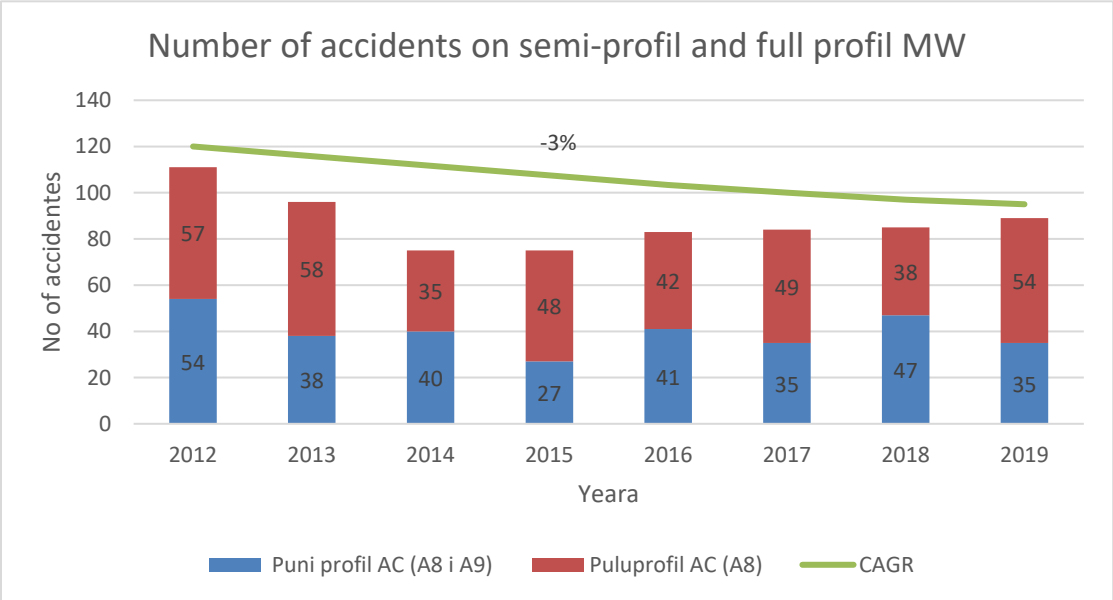
In addition to traffic safety, the construction of the second bore of the Učka tunnel significantly affects the tourism and economy of the Istria and Primorje-Gorski Kotar County, not only construction companies, but also other large companies in the field of project construction.

1.1 Traffic safety

1.1.1 Traffic accidents

The analysis of traffic accidents on the highway profile and on the full profile of the highway was done in the context of the historical number and costs of traffic accidents on the full profile of the highway and the highway profile and projections for the future. The number of accidents was analyzed from the perspective of the total number of accidents, and then the numbers of accidents on the semi-profile and on the full profile of the motorway were compared. In order to better show the differences between the full profile and the semi-profile of the motorway, the number of accidents per kilometre of the motorway was additionally observed.

Graph 1 - Number of accidents on the semi-profile and on the full profile of the motorway



Source: internal source, Bina-Istra d.d.

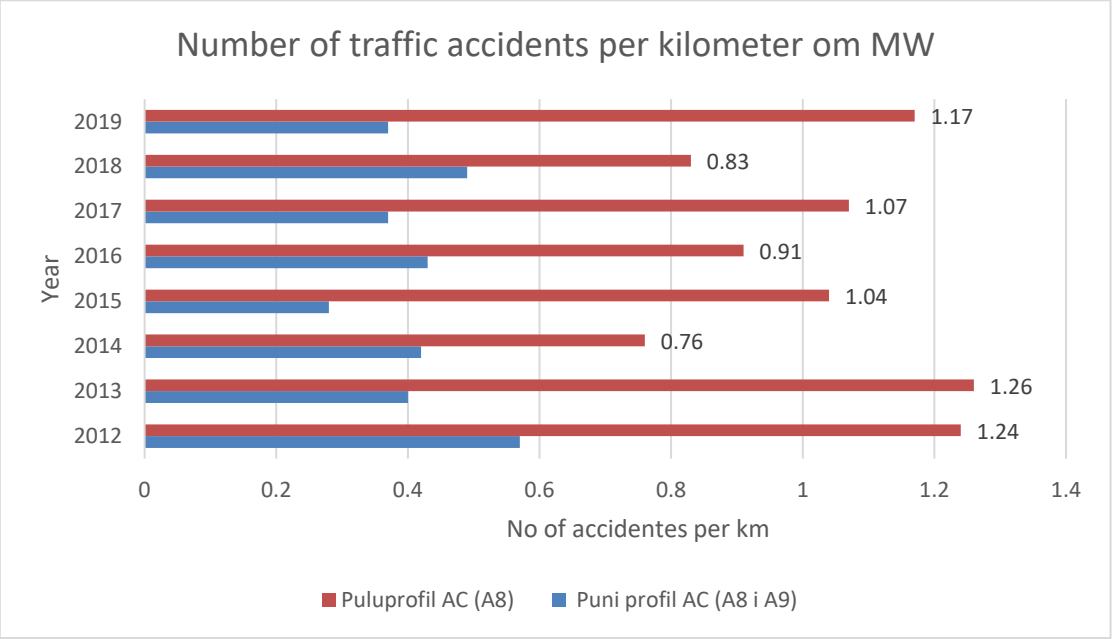
The analysis shows that the number of traffic accidents in all observed years is higher on the part of the motorway built in half profile (with two traffic lanes), except of 2014 and 2018, which can be attributed to the implementation of additional safety measures on the highway profile by the concessionaire and operator together with the Istrian police administrations. Namely, security measures were strengthened in 2014 and 2018, primarily through intensified police controls on the highway, along with increased efforts to raise user awareness of the importance of complying with traffic rules.

In 2012, the highest total number of traffic accidents was recorded - 111, and the lowest total number of traffic accidents was recorded in 2015 - 75.

To better understand and understand the general trend, a compound annual growth rate (CAGR) calculation was used. This mode of analysis records different trends within the general trend, if any. The number of traffic accidents dropped significantly between 2012 and 2014 with an annual rate, CAGR, of 17.8%. Then, after a year of stagnation, the number of traffic accidents increased from 75 in 2015 to 89 in 2019. The CAGR in the period of traffic accident growth from 2015 to 2019 is 4.4%. This continuous growth from 2015 to 2019 can be recognized as a potential issue of motorway safety that needs to be addressed urgently. However, the general trend of the observed period from 2012 to 2019 is satisfactory, as the number of accidents decreases with the growth of traffic in the same time period.

The total number of accidents is an interesting indicator, but the analysis of the number of accidents per kilometre of motorway gives a better perspective on the differences between a full-profile motorway and a semi-profile motorway. What we cannot see from the total number of accidents and what is very important for the final conclusion of this paper is how many accidents occur per kilometre of motorway, both on the full profile and on the semi-profile of the motorway. The number of accidents per kilometre is actually a number that shows that the full profile of a 4-lane motorway is actually safer and therefore more favourable and better for users than a semi-profile of a 2-lane motorway - such as the existing sub-phase section 2B2-1.

Graph 2 - Number of traffic accidents per kilometre on motorway



Source: internal source, Bina-Istra d.d

Regarding the average length of the trip:

• on the highway profile it is 46 kilometers, while

• on the full profile of the motorway, it is twice as long, ie 95 kilometers.

The analysis of traffic accidents per kilometre shows that the highway in full profile is significantly safer than the highway in half profile. This result is expected, primarily due to the larger number of traffic lanes, which in the case of a full-profile motorway give drivers the opportunity to overtake in one of the two lanes in use, which is not the case on a semi-profile motorway.

In both observed cases, the results oscillate in the observed period, from 2012 to 2019. On the motorway in the semi-profile, the highest recorded number of traffic accidents, 1.26 accidents per kilometre of motorway, was recorded in 2013, and the lowest number, 0.76 accidents per kilometre of motorway, was recorded in 2014. On the motorway in full profile, the highest number of recorded accidents, 0.57 accidents per kilometre of motorway, was recorded in 2012, and the lowest number of recorded accidents - 0.28 accidents was recorded in 2015 and 2019. In all years, the average number of accidents per kilometer of highway is 2.5 times lower on the highway in full profile compared to the highway in full profile. On the half-profile, the average is 1.04 accidents compared to the average of 0.42 accidents on the full profile.

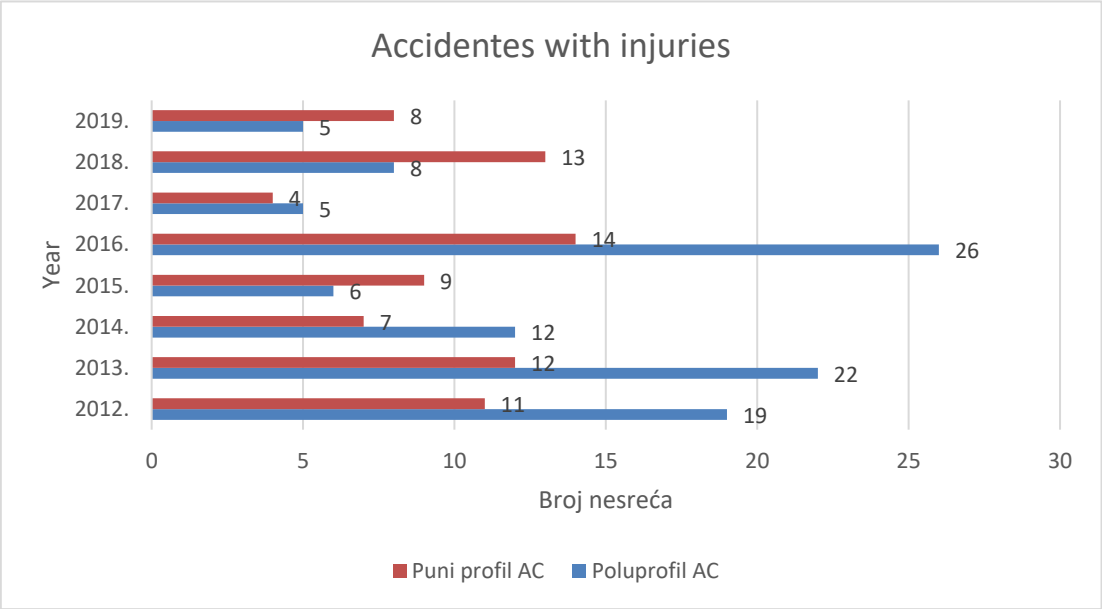
The biggest difference between the full profile and the half-profile of the highway was recorded in 2013, when there were almost 0.9 accidents per kilometre more on the highway in the half-profile. On the other hand, in 2014 and 2018, the number of accidents per kilometre was only 0.34 higher on the half-profile compared to the full profile. These are two years and the only two years with a higher number of accidents on the highway in full profile than on the highway in full profile.

1.1.2 Accidents with injured persons

Accidents with injured persons were analyzed in the context of accidents on the highway in half profile and highway in full profile. As expected, higher costs were incurred in accidents with injured persons on the highway in the semi-profile compared to accidents with injured persons on the full profile of the motorway.

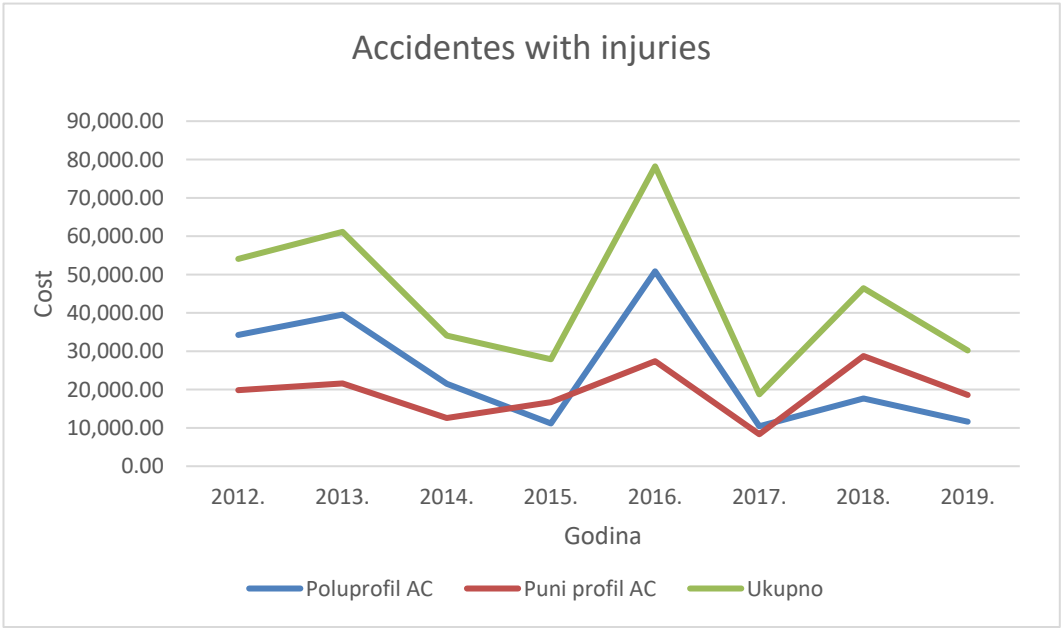
As shown in the previous table, the costs incurred as a result of accidents are quite oscillating, and the highest generated cost on both the semi-profile motorway and the full-profile motorway was realized in 2016. According to the calculation presented above, in 2016 the cost of accidents with injured people in the semi-profile reached a total of EUR 50,800.00, while the same cost on the highway in full profile in 2016 was a total of EUR 27,400.00. The lowest cost generated, again total on the highway in the semi-profile and the highway in the full profile was in 2017. The cost of accidents with injured persons in the semi-profile amounted to a total of EUR 10,400.00 that year, and EUR 8,300.00 in the full profile. Accidents with injured people on the highway in full profile created a higher cost compared to accidents without fatalities on the highway in full profile in 2015 and 2018 alone.

Graph 3 - Number of accidents with injuries on the full profile and on the semi-profile of the motorway



Source: author's analysis

Graph 4 - Cost of accidents with injuries on the full profile and on the half profile of the motorway



Source: author's analysis

As mentioned earlier, the general trend fluctuates greatly from year to year, and making reliable conclusions is quite difficult. These disturbances are the result of a not very large number of accidents, which is accompanied by very high and growing traffic, where even a

very small change in the actual number of accidents can produce a large difference in the observed accident costs. For example, the total number of accidents, with fatal consequences or those without fatal consequences, as well as other accidents, was not the highest in 2016, but was actually lower than the highest point in 2012 by more than 25%. However, accident-related costs were a total of over € 20,000 in 2016 compared to 2012, as shown in the figure.

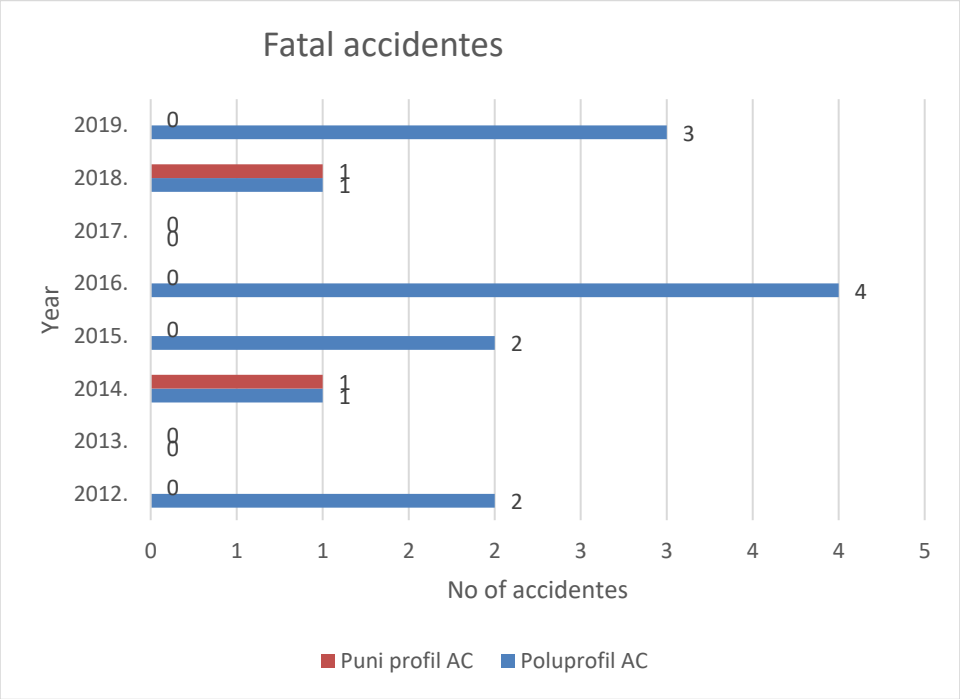
When comparing the full-profile highway and the semi-profile highway, the cost of accidents with injuries is another reason that supports the need to build Phase 2B2-1.

1.1.3 Fatal accidents

Fatal accidents were also observed in the context of half-profile highway accidents and full-profile highway accidents.

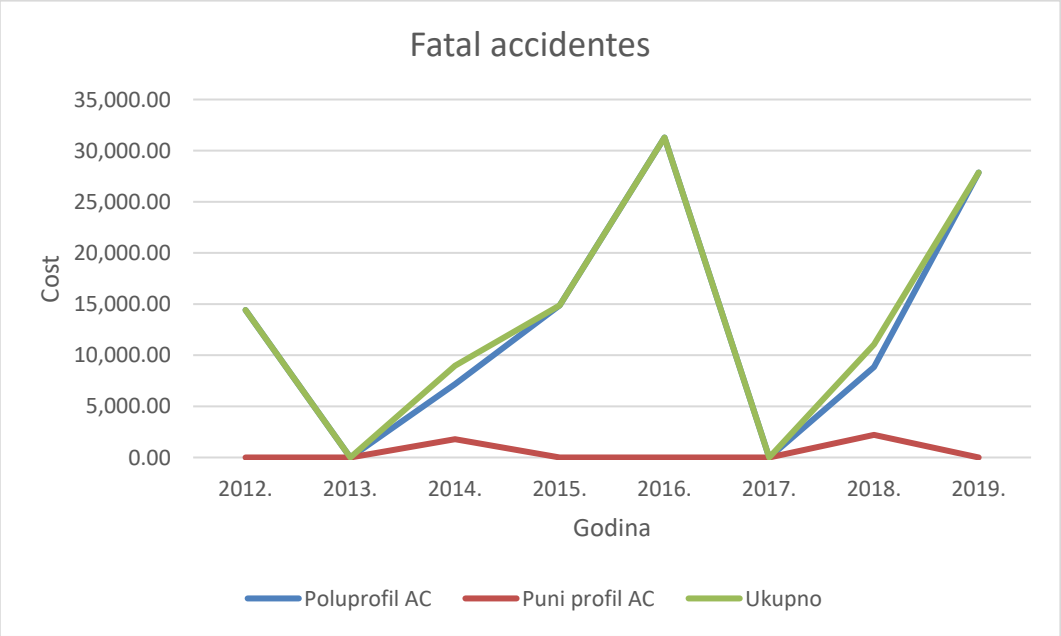
In the period of 8 years, between 2012 and 2019, a total of 15 accidents occurred with fatalities on the half profile and full profile of the highway. 13 of the 15 fatal accidents occurred on the highway profile and two more on the highway in full profile. Given that due to the small total number of accidents, this number is difficult to compare with the number of vehicles using the highway, the oscillations that can be seen in the figure below are expected.

Graph 5 - Number of fatal accidents on the half profile and on the full profile of the motorway



Source: author's analysis

Graph 6 - Cost of fatal accidents on the semi-profile and on the full profile of the motorway



Source: author's analysis

The highest cost caused by fatal accidents was recorded in 2016, with four fatalities on the highway in half profile, and in the same year there were no similar accidents on the highway in full profile. As for the highway in full profile, one fatal accident occurred in 2014 and 2018.

The difference in cost that can be seen in the figure is a result of the difference in GDP over the years. As explained earlier, accident costs are directly related to GDP per capita, and its growth is the reason for higher calculated costs for the same number of accidents in different years observed. In addition, in terms of fatal accidents, in 2 of the 8 years observed, the cost of fatal accidents was the same on the motorway in full profile and on the motorway in full profile (in two years the costs were equal to zero), with 6 out of 8 observed years without accidents with fatalities on the motorway in full profile and 2 out of 8 observed years on the motorway in semi-profile. This shows, as stated earlier, that the number of fatal accidents is difficult to compare with traffic density, and that oscillations occur due to a large change in percentages based on a very small change in the actual number of fatalities.

Taking into account all the above, the highway in full profile is a project that should increase the safety of infrastructure users in terms of reducing the number of accidents, and thus reducing the cost of accidents. The need for construction can be argued by the fact that on the full profile of the Istrian highway since 2012 there have been only two accidents with fatalities, while on the semi-profile of the highway there have been almost 2 (1.88) accidents with fatalities.

1.2 Directive 2004/54 / EC

Raising the level of safety of tunnel users, including the safety of Učka tunnel users, is a topic that is very interesting for the EU and its issue is addressed in a special document - Directive no. 2004/54 / EC of the European Parliament and of the Council on minimum safety requirements for tunnels in the TEN-T network, of 29 April 2004. This Directive was adopted with the assistance of various international professional bodies, such as UNECE and PIARC, measures in tunnels longer than 500 meters that are part of the trans-European road network (TEN-T).

Directive 2004/54 / EC proposes different safety measures to be implemented depending on the different categories of tunnels, including:

- minimum requirements for all tunnels,
- infrastructure measures,
- tunnel geometry,
- escape routes and emergency exits,
- drainage,
- fire resistance,
- lighting,
- etc.

This paper mainly deals with the proposals of the Directive regarding infrastructure measures, more precisely the exact number of tunnel bores and strips, as the main topic of the paper.

In accordance with Croatian legislation, for all tunnels on the TEN-T network in Croatia, their compliance with the Directive must be checked, so in 2006 a safety audit of the Učka tunnel was conducted based on regulatory compliance with this Directive. Although the then traffic levels in the Učka tunnel did not justify the construction of a second tunnel bore, the analysis concluded that the existing Učka tunnel, as a two-way tunnel with one tunnel bore with longitudinal ventilation system and no emergency exit along the entire length of the tunnel, did

not comply with minimum requirements. Directive. The conclusion of the safety audit led to further analysis of the tunnel and finally to the adoption of a proposal for the construction of a second tunnel bore to allow one-way traffic in each tunnel bore.

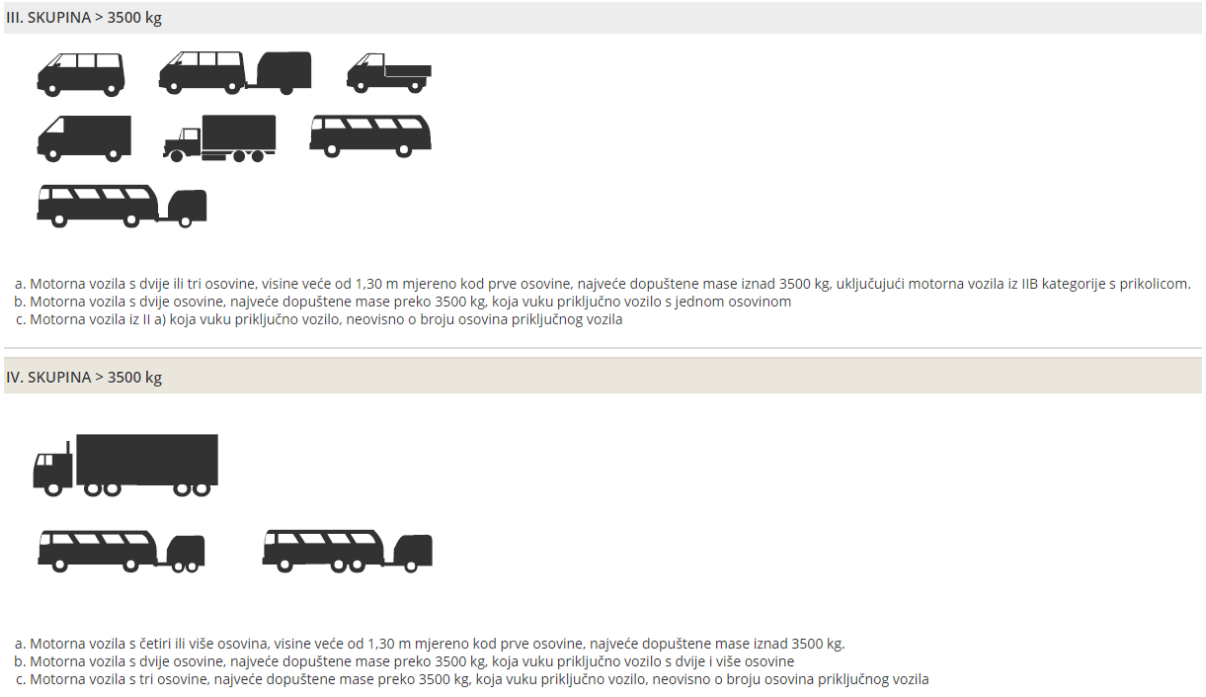
The Učka Tunnel has certainly been managed without major fire incidents since its inception and opened to traffic in 1981. This can undoubtedly be attributed to the introduction of many compensatory risk mitigation measures to ensure the safety of tunnel users and staff. As an example, the already mentioned unique electric two-way vehicle for escape and evacuation of users and emergency personnel can be singled out.

1.2.1 Advantages in tunnel maintenance

There are great benefits for the construction of the second bore of the Učka tunnel and for the workers who work on its maintenance. The main reason is their safety, and after that the possibility of performing maintenance work in one bore, while it is completely closed due to the renovation and traffic is redirected to another tunnel bore.

Currently, all maintenance work is performed in one traffic lane with special traffic regulation during maintenance work or, if there is a major maintenance intervention, then the tunnel should be completely closed which means that certain vehicles (categories III and IV) have a problem, with since these categories cannot use alternative routes to come to Istria.

Picture 1 - Vehicles III. and IV. categories



Source: web Bina-Istra d.d.

Therefore, additional traffic lanes on the sections or an additional bore of the Učka tunnel would enable and significantly facilitate the necessary works of regular and extraordinary maintenance.

1.2.2 Advantages for traffic flow

The number of disruptions to the normal flow of traffic would be significantly reduced by the launch of the second tunnel bore, mainly due to a reduction in the number of the main causes of traffic disruptions, such as:

• traffic accidents,

• maintenance work and

• waiting time for passage.

Traffic accidents - due to the lower number of accidents on high-profile motorways compared to semi-profile motorways, the number of traffic disruptions would be reduced.

Maintenance works - today when maintenance works are performed on the highway in a semi-profile or in the Učka tunnel with only one tunnel bore, all traffic during the works takes place in one lane alternately, with temporary traffic regulation, which significantly slows down or disrupts normal traffic flow.

Waiting time - traffic jams by building a second tunnel bore would no longer be a problem, at least it would not be proportionate to today's problem.

All the factors described above show different positive effects of the construction of the second bore of the Učka tunnel on a significant reduction of disturbances in the normal traffic flow.

1.3 Duration of the trip

The analysis in this part of the paper will focus on the duration of the journey after crossing from the semi-highway to the highway in full profile and on waiting at the toll station of the Učka tunnel before and after the completion of the second bore of the Učka tunnel.

1.3.1 Time value

Data from the 2016 “Values of travel time in Europe” study by Wardman, Chintakayala and De Jong will be used to show the time difference between traveling using a half-profile motorway and a full-profile motorway.

The main parameter is the value of time (VoT), a parameter used for transport planning in different countries and organizations that have official values of this parameter in order to consistently evaluate projects and different programs. Basically, this metric helps cash in on time. Time monetization in this sense is used to compare alternative travel routes. Crucially, because of the value of time, one route can be cheaper than another, even if it has toll collection, while the other does not have toll collection.

Basically, calculating the time value is pretty simple:

• the first step is to calculate the difference in travel duration between the alternative routes being observed,

• in the second step, the corresponding monetary value associated with the time difference of the duration of the trip from the first step is added.

This procedure shows whether tolls paid for motorway travel can be compensated by the time saved by choosing a specific route, ie in this case the difference between full-profile motorway travel compared to semi-profile motorway.

According to the study, the average time value to be applied to travel within Croatia is:

• 52 HRK per hour.

The study states that long-distance travel is evenly distributed between business travel and leisure travel, and with this in mind it is not possible to distinguish between seasonal and off-season values, so the value of 52 HRKper hour is the average for the whole year.

There are two routes from Istria to Matulji via the Istrian Y:

• Umag-Matulji and

• Pula-Matulji.

Both routes pass through the Učka tunnel and the Vranje-Matulji section. This paper will analyze both routes and their alternatives, in order to determine the actual value of using the Istrian Y instead of alternative routes.

1.3.2 Waiting time at toll tunnel stations

Apart from the statistical data that the concessionaire collects for its own needs, there are no precise data collected for the purpose of analyzing the waiting time problem at the toll stations of the Učka tunnel. From media reports and regular reports of the Croatian Auto Club (HAK) it is obvious that during the summer period every weekend at the entrance and exit of the Učka tunnel traffic jams are created and that the queues are on average several kilometers long.

Although it is not possible to exactly quantify the shortening of the waiting time after the construction of subphase 2B2-1 due to limited input data, it is expected that additional traffic lanes and the second tunnel bore will accelerate the traffic flow. Also, the second traffic lane will offer the possibility of redirecting traffic, but also the possibility of faster driving through the Učka tunnel itself.

According to Bina-Istra data, in 2014 the total turnover amounted to 8.1 million transactions, while in 2019 this number reached 10.5 million, which is an increase of almost 30% over a period of 5 years or an average of almost 6 % per year. At the same time, revenues recorded even more significant growth. In 2014, toll revenues amounted to HRK 205.71 million, while in 2019 it is projected to amount to around HRK 315 million, which is an increase of 53% in the observed period or an average of 10.6% per year.

Optimistic forecasts for Croatia in the form of raising the credit rating to the investment grade in mid-2019, should have a stronger effect on economic growth, and thus a further positive effect on turnover and revenue figures.

Finally, the section of subphase 2B2-1 is the most used section of the road in Istria, which connects Pula and the Istrian peninsula with the two main economic centers in the Republic of Croatia, Rijeka and Zagreb. The problems of heavy traffic jams, especially in the summer, should be solved after the realization of subphase 2B2-1. In addition, after Matulji, the end point of the Bina-Istra concession, there is a semi-profile motorway (about 2 km to the Rijeka bypass) which the concessionaire Hrvatske autoceste d.o.o. (until recently ARZ d.d.) was to double in parallel with the construction of sub-phase 2B2-1. After the completion of both sections, the

the Republic of Croatia plan is to have a full profile of the motorway on the full length of the route from Pula to Zagreb.

1.4 Environmental protection

The construction of the second bore of the Učka tunnel has a significant impact on the environment. The main focus is on a closed drainage system, water protection and animal protection. There are of course other positive impacts that have been considered. The conclusions were guided by the Environmental Impact Study conducted by the company Hidroelektra-projekt d.o.o., which was a prerequisite for the preparation of project documentation and implementation of the administrative procedure, among others, for subphase 2B2-1.

In the construction of sub-phase 2B2-1, the concessionaire intends to construct a closed drainage system on the entire section. This means that all wastewater, oil and dirty liquid will be collected from the road and drained into a closed drainage system.

Currently, all wastewater, oils and dirty liquids end up in nature. This is especially important because subphase 2B2-1 is located in the Učka Nature Park. All wastewater will be collected and filtered in a closed drainage system, in water treatment and recycling plants before being discharged back into the environment.

Picture 2 - Učka Nature Park

Source: web, Public Institution Učka Nature Park

The goal of these additional investments is to preserve the nature of the Project. As there is no closed drainage system on the existing motorway in the semi-profile on this section, many

local houses face problems with the application of water and materials during rainy days in the Primorje-Gorski Kotar County. A closed drainage system will contribute to the controlled discharge of rainwater and the prevention of local sediments and torrents that cause material damage.

In addition, the number of traffic accidents caused by large amounts of rainwater that is not properly drained into a closed drainage system today will be reduced, and there is a risk of aquaplaning in situations of high rainfall in a short period of time.

Animal protection can be viewed as animal safety and consequences for wildlife during highway construction, as well as consequences after construction is completed.

The construction of new viaducts and overpasses will ensure that animals can cross the road, and thanks to their frequency, the Environmental Impact Study states that there is no need to build special crossings for animals, but that the passages between the pillars will serve as a route for animal migrations. The route of subphase 2B2-1 of the motorway with its longest and most important part - the new bore of the Učka tunnel, passes through the Učka mountain, which means that this part of the subphase will not intersect the natural migration routes of animals.

From the aspect of impact on the fauna, safety fences will be mentioned that will be installed on both sides of the highway and will ensure and reduce the number of animals entering the road, protecting wildlife and also helping to avoid possible traffic accidents.

According to the environmental impact study, with the construction of this phase of the Istrian Y, all animal protection requirements will be met. For example, on more than half of the section there is no need for additional passages for animals due to the population density in the area. The second part of the section are tunnels where there is also no harmful impact on wildlife.

1.5 Trans-European road network

The upgrade of the Comprehensive Trans-European Transport Network (TEN-T) is a project developed and co-financed by the European Union, and the decision to adopt the project was taken by the European Parliament and the Council of Europe in July 1996. The central idea of the development of the TEN-T network is to finance the establishment of transport infrastructure that will connect all EU member states. The project is aimed at the planned construction of a network of road, rail, air and maritime infrastructure.

The TEN-T network is part of a broader plan called Trans-European Networks (TENs) that includes telecommunications and energy. The TEN-T project should monitor and integrate improvements to primary roads, railways, airports and seaports, together with traffic management systems.

It is important to note that the TEN-T plan is divided into two layers:

• "comprehensive network" or

• core network.

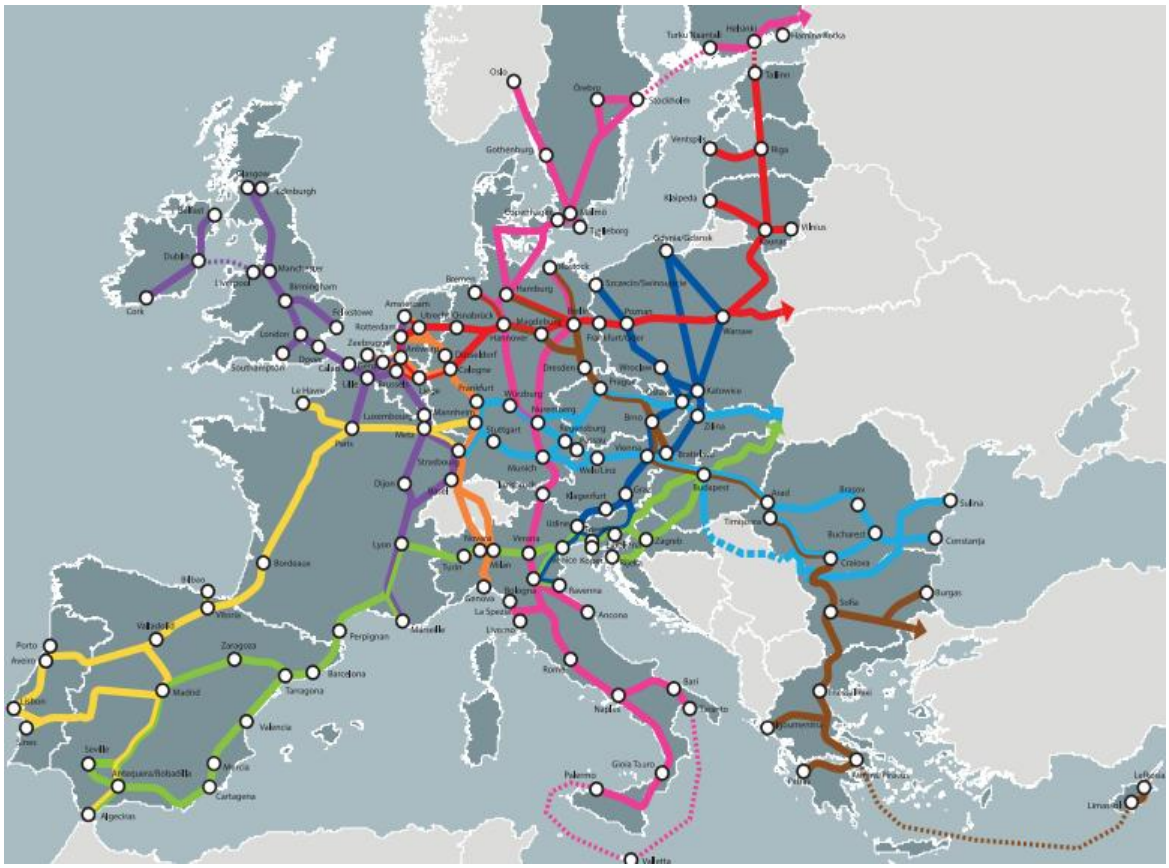
The comprehensive network includes balanced infrastructure development, accessibility of all regions, including the most remote, coherent core standards throughout the network and traffic management systems, and should be completed by 31 December 2050.

Picture 3 - TEN-T Comprehensive Network

Source: web, TENtec, www.ec.europa.eu

On the other hand, the core network includes a subset of a comprehensive network of the highest strategic importance and has the highest priority in implementation and must be completed by 31 December 2030.

Picture 4 - TEN-T, basic network



Source: web, TENtec, www.ec.europa.eu

The basic network is part of a comprehensive network that includes infrastructure that is expected to be used more. The basic network was identified on the basis of a certain statistical criterion, and it contains:

• in the vicinity of capital cities and

• cities with more than 1 million inhabitants,

• ports with transhipment above 1% of the total transhipment of all ports in the EU,

• airports with an annual passenger / air traffic level of at least 1% of the corresponding total number in the EU and

• similar

1.5.1 Impact of TEN-T network construction

The European Commission study, "The impact of TEN-T completion on growth, jobs and the environment" of 30 November 2018, aimed to assess the impact on economic growth, jobs and greenhouse gas emissions resulting from the completion of the basic TEN-T T networks. These goals are closely linked to the three main goals of European policy-making:

• stimulating growth,

• job creation and

• climate change mitigation.

The study highlighted the following key objectives:

• 800,000 new employees in 2030 through the completion of the core TEN-T network

• During the construction period (2017-2030), 7.5 million jobs will be created cumulatively

• Additional GDP growth of 1.6% will be achieved in the period from 2030

• reduction of carbon dioxide emissions of 26 million tons during the construction period in the transport sector.

1.5.2 TEN-T in Croatia

The TEN-T project includes Croatia in comprehensive corridors and core network corridors. The comprehensive network includes a total of 14 comprehensive points of interest and 5 more core points of interest in Croatia.

Picture 5 – Map of TEN-T projects in Croatia

Source: web, TENtec, www.ec.europa.eu

The comprehensive network in Croatia consists of 6 airports, 6 seaports and 2 land ports. The main points of interest are two corridors - the Mediterranean and the Rhine-Danube. The Mediterranean corridor connects the Iberian ports with Marseilles and northern Italy, and then with Slovenia, Croatia, Hungary and Ukraine. The Rhine-Danube corridor connects Strasbourg and Germany with Eastern Europe.

Table 3 - TEN-projects in Croatia

Junction	Airport	Sea port	Land port	Railway terminal
Dubrovnik	Comprehensive	Comprehensivea		
Osijek	Comprehensive		Comprehensive	
Ploče		Comprehensive		
Pula	Comprehensive	Comprehensive		
Rijeka	Comprehensive	Basic a		
Šibenik		Comprehensive		
Sisak			Comprehensive	
Slavonski Brod			Basic	
Split	Comprehensive	Comprehensive		
Vukovar			Basic	
Zadar	Comprehensive	Comprehensive		
Zagreb	Basic a			Basic

Source: web, TENtec, www.ec.europa.eu

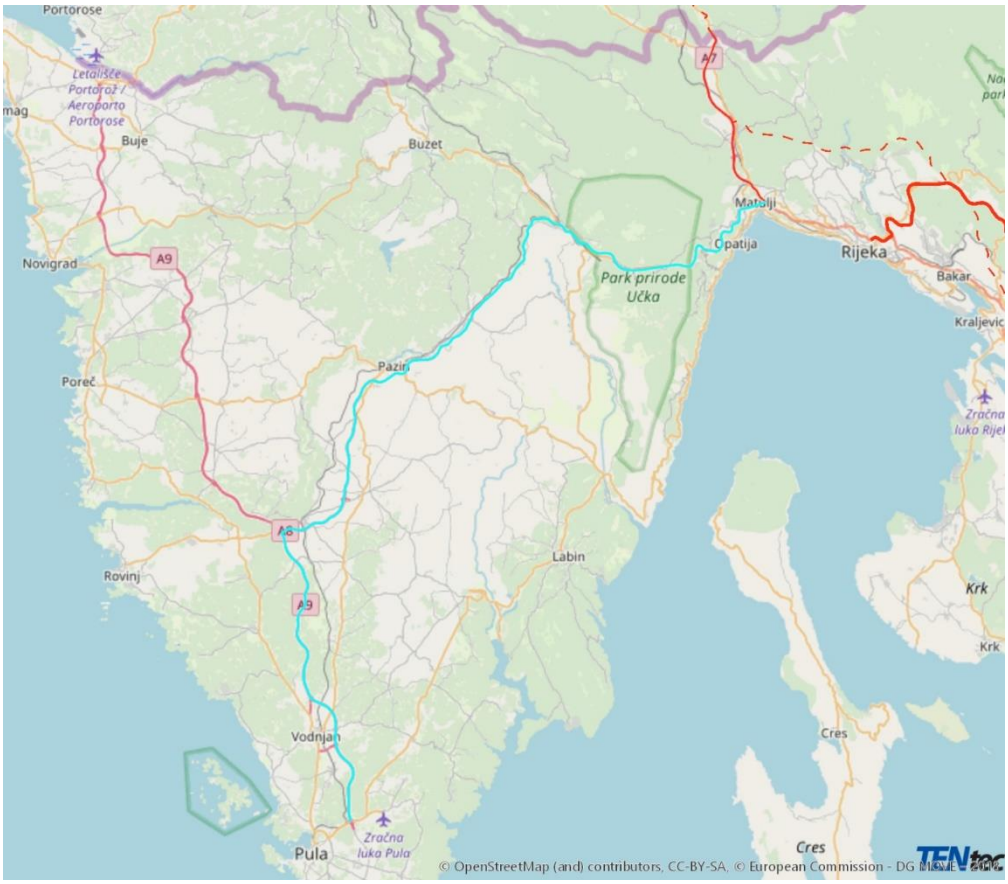
All this shows that subphase 2B2, as part of a comprehensive TEN-T network, is of great interest to the Republic of Croatia, primarily due to the improvement of infrastructure, and also because all other network points (airports, seaports, etc.) will be better connected after the completion of a road (motorway) as part of a comprehensive TEN-T network.

1.5.3 Phase 2B2 of the Istrian Y and TEN-T network

As explained earlier, phase 2B2 is certainly of interest to the Republic of Croatia and the European Union, primarily due to its inclusion in the TEN-T network. Two parts of the Istrian Motorway Project are included in the comprehensive TEN-T network:

- • section Matulji-Kanfanar and
- • section Kanfanar-Pula.

Picture 6 – Parzs of Istrian Y atTEN-T



Source: web, TENtec, www.ec.europa.eu

An important part of the Matulji-Kanfanar section is actually subphase 2B2-1. This shows the importance of subphase 2B2-1 and its direct effect on the comprehensive TEN-T network. The previous picture shows the comprehensive TEN-T network in Istria. Prominent roads are part of the comprehensive TEN-T network and include sub-phase 2B2-1. The two airports and seaports that are part of the comprehensive network are also visible on the map - Rijeka and Pula. This is another factor that emphasizes the importance of subphase 2B2-1.

Since part of the Matulji-Kanfanar section is crucial in connecting different parts of the comprehensive TEN-T network (Rijeka and Pula hubs in this case) the added value of subphase 2B2-1 in the comprehensive TEN-T network is easily visible, which gives additional positive argumentation to the project. With this in mind, it can be said with certainty that sub-phase 2B2-1, primarily 2B2-1A, is important not only for the Republic of Croatia, but also for the European Union as a whole, following their policies aimed at better interconnection of regions and infrastructural improvements.

1.6 Local community and economy

In the final part of this paper, the potential benefits of subphase 2B2-1 for the local community and for the national economy are analyzed. The impact of sub-phase 2B2-1 on the local community was analyzed through the creation of business zones and employment. On the other hand, the impact on the national economy was observed through the analysis of the impact on tourism and GDP.

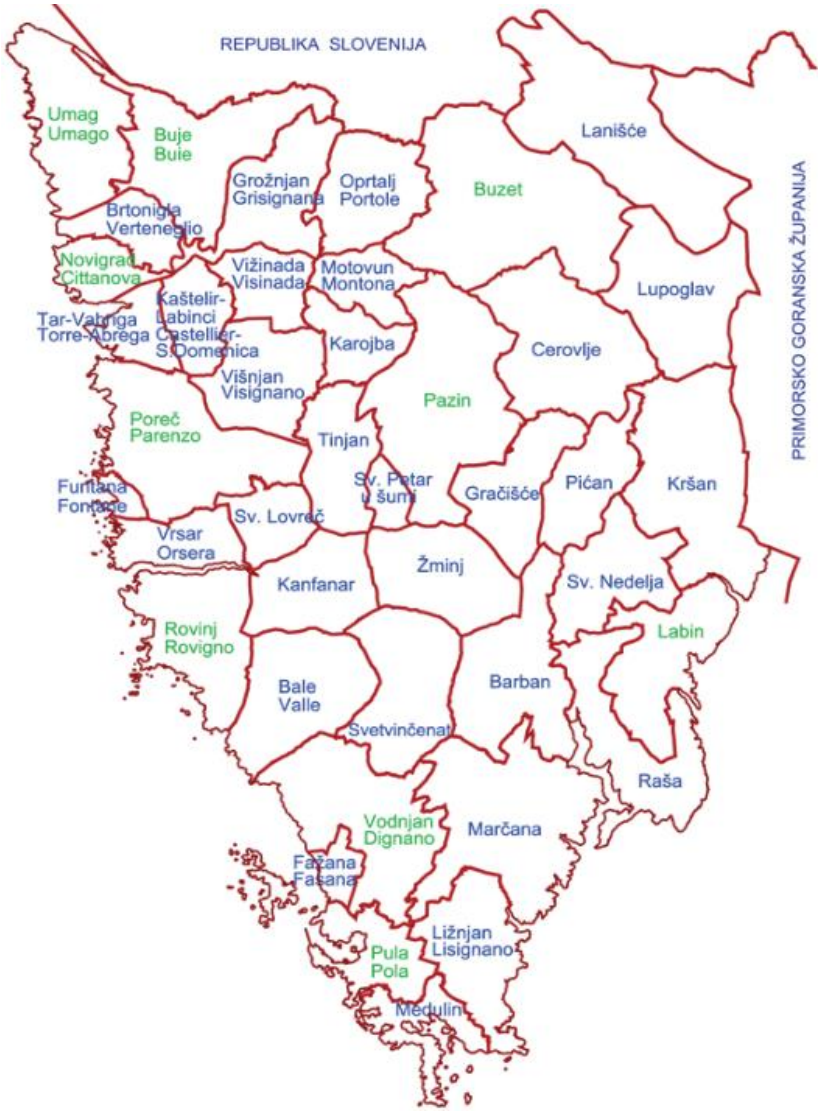
1.6.1 Construction of the Istrian Y and the County of Istria

The construction of the Istrian Y is the largest infrastructure project in the Istrian County, and its significance and impact correspond to the set goals of several important documents of the Government of the Republic of Croatia: Transport Development Strategy of the Republic of Croatia (OG 84/17), Spatial Development Strategy of the Republic of Croatia (OG 106/17) and Tourism development strategies of the Republic of Croatia until 2020 (OG 55/13). The fact is that the developed infrastructure contributes to the development of all economic branches, including tourism, and the local community. The positive effects of construction can be divided into 4 main effects:

- impact on the economy
- impact on tourism
- impact on GDP and budget i
- impact on traffic, transport of goods and safety.

The construction of the Istrian Y has a great impact on the development of the region and the Istrian economy as a whole. Istria County is divided into 10 cities and over 30 municipalities.

Picture7 - Cities and municipalities of Istrina County



Source: web Istrian County, www.istra-istria.hr

Its headquarters are in Pazin, while the city of Pula is the main center of the County in terms of finance, economy, science and culture. Favorable geographical position and availability of natural resources, together with historically developed exchange of goods and skilled labor, help Istria County to achieve better economic results in certain areas compared to other counties, and even compared to the Republic of Croatia as a whole.

In 2018, the results of the Istria County were among the best in the Republic of Croatia. This is confirmed by the County Economic Strength Index, published by the Croatian Chamber of

Commerce, which is based on the average values achieved in the last 3 years, as can be seen from the table below.

Table 4 - HGK County Economic Strength Index, 2018

County	GDP per resident average 2012. - 2014. index, RH=100	Average net salary per employee, average 2013. - 2015, index, RH=100	Total revenues entrepreneurs per employee, average 2014. - 2016, index, RH=100	Net profit entrepreneurs per employee, average2014. - 2016, index, RH=100	Revenue at foreign market by employee, average2014. - 2016, index, RH=100	Unemployment rate average, 2014. - 2016, index, RH in regards to county	Demography - index changes number residents 2021./2011.	HGK indeks of economic strength, RH=100
Grad Zagreb	177,8	116,9	130,5	132,6	102,6	201,3	100,9	147,6
Istarska	124,2	99,0	86,4	138,4	140,7	187,5	98,8	127,3
Primorsko-goranska	125,8	99,9	76,1	71,8	88,4	127,7	97,0	105,5
Varaždinska	82,0	80,4	77,8	57,9	149,4	155,1	98,1	99,6
Zagrebačka	76,5	96,2	118,7	89,9	100,7	105,9	102,3	95,2
Dubrovačko-neretvanska	97,8	99,2	66,4	100,4	64,8	96,9	98,4	92,1
Zadarska	80,0	95,7	76,9	86,2	100,8	103,9	102,1	91,3
Međimurska	83,5	81,9	62,1	59,2	112,0	128,6	97,9	91,0
Koprivničko-križevačka	86,3	92,4	82,8	79,5	100,7	96,1	96,5	90,7
Krapinsko-zagorska	62,5	86,0	74,9	76,2	132,6	109,4	97,0	87,1
Karlovačka	75,0	94,5	72,0	110,2	92,7	82,6	90,2	85,8
Osječko-baranjska	79,1	91,5	85,6	66,1	88,3	61,5	96,1	80,9
Splitsko-dalmatinska	76,7	94,4	76,2	82,8	62,1	74,2	98,1	80,8
Sisačko-moslavačka	76,3	92,4	73,2	36,7	146,3	56,8	87,1	79,7
Šibensko-kninska	78,2	92,5	66,0	62,4	60,2	82,0	89,2	77,6
Vukovarsko-srijemska	58,4	86,8	103,4	86,7	92,0	57,7	92,3	77,3
Ličko-senjska	76,4	91,0	61,2	69,6	52,0	83,2	85,6	76,0
Brodsko-posavska	56,6	88,1	67,3	47,2	108,7	60,9	93,4	71,6
Bjelovarsko-bilogorska	67,6	84,0	65,5	41,3	49,0	64,6	91,8	68,0
Požeško-slavonska	58,8	86,2	57,5	44,0	68,6	72,7	89,5	67,9
Virovitičko-podravska	58,3	83,6	65,0	48,6	81,0	54,8	92,3	67,7

Source: web, HGK

The Istrian County Index in 2018 is almost 30% higher than the average of the Republic of Croatia and 2% higher than the average result of the Istrian County in 2017. This clearly indicates that the Istrian Y is needed by the Istrian County in order to grow even faster, and that the developed transport infrastructure is one of the reasons for the development of the Istrian County as a whole.

1.6.2 Impact on employment

As mentioned earlier, the construction of motorways is one of the largest infrastructure projects in the history of the Republic of Croatia. One of the factors on which economic growth depends the most are, of course, transport links. Transport connections are also an important indicator of the development of a particular county, region and country. Currently, according to the number of employees, the construction of subphase 2B1 is the largest construction site in the Republic of Croatia. It is important to note that most of the workers on the construction of subphase 2B1 are citizens of the Republic of Croatia, which brings many benefits, both during construction and after it.

Due to the construction of the Istrian Y and its new section, subphase 2B1, at this time the possibility of building an industrial zone for the production of materials for the construction of this section of the highway has increased. Namely, in the period that began in 2008, which coincides with the beginning of the construction of the second carriageway of the 100 km long motorway, ie the addition to the full profile of the motorway completed in 2011, significant investments in Istria County were used for restructuring and increasing the competitiveness of the county economy. Major infrastructure projects include the Istrian Y, the Butoniga water supply system and the Pula - Karlovac main gas pipeline. Several industrial facilities and 20 business zones were also built. As stated in the Istrian County Entrepreneurial Zones Development Program, the establishment and construction of entrepreneurial zones achieves multiple goals for the development of the local region and community: creating new jobs, encouraging economic development in a particular area and encouraging entrepreneurship and investment. At the level of economic entities, the advantages of entrepreneurial zones are reflected in solving the problems of space and infrastructure, enabling the joint use of infrastructure and connecting entrepreneurs located in the same area, including quality transport

connections of these areas with major transport routes and a system of incentives and benefits. . All of the above ultimately results in the rationalization of the entrepreneur's business. Based on the existing spatial planning documentation, infrastructure equipment and available workforce in the area, the Istrian Development Agency (IDA) has identified 34 strategic zones with priority status, which collectively occupy an area of more than 1,300 ha, and most of them are located near the Istrian y.

From the analysis of the annual financial statements for 2018, prepared by the Croatian Chamber of Commerce, it is noticeable that the most significant activities in the Istrian County are:

- tourism,
- trade and
- production.

These three activities alone generate almost 70% of the County's total revenue.

1.6.3 Impact on tourism

The impact of subphase 2B2-1 on tourism is of great importance for the County of Istria. In addition to a favorable geographical position, important components of the tourist offer are history, culture and gastronomy. Therefore, it is not surprising that the County of Istria is the region with the largest number of tourist nights in the Republic of Croatia. According to the official tourist portal of Istria and the Central Bureau of Statistics, in 2017, more than 4.22 million tourists (both foreign and domestic) visited Istria. In the same year, the Republic of Croatia registered 17.43 million tourists, which means that the County of Istria realizes about 25% of the total number of tourist visits to the Republic of Croatia. In 2018, the number of tourist visits increased to 4.46 million in the County of Istria and to 18.67 million in the Republic of Croatia. Data for 2018 for the County of Istria are at the level of those in 2017 in terms of share in the total number of tourists.

Table 5 - Number of tourist arrivals, Croatia and Istrian County

	2014	2015	2016	2017	2018
Number of Touristic Arrivals (Republic of Croatia)	13.128.416	14.343.323	15.594.157	17.430.580	18.666.580
Number of Touristic Arrivals (Istrian County)	3.272.280	3.570.668	3.852.114	4.223.233	4.456.792
% - Istrian County vs Republic of Croatia	24,93%	24,89%	24,70%	24,23%	23,88%

Source: web, istra.hr

The Istrian Y, as the main road in the Istrian County, connects various tourist centers on the coast with cities in the interior and has a huge impact on tourism. According to the Istrian Tourist Board and Bina-Istra, 95% of the total number of tourists come to Istria by car. According to these data, the Istrian Y is primarily a tourist highway, and the construction of the highway itself has contributed to the development of tourism.

Slovenian and Italian weekend tourists have benefited the most in the context of tourism development, and they can now travel to Istria and Croatia much easier, safer and faster. Although tourists are mostly satisfied with the Istrian motorway, some of them are still not satisfied with the section of the motorway from Učka to Kanfanar. This only points to the importance of sub-phase 2B2-1 in the context of tourism:

• Additional lane in both directions guarantees fewer accidents.

• Better quality of transport infrastructure improves the connection between airports and final destinations in Istria.

• if the fact that 95% of tourists come to Istria by road, it is necessary that investments in infrastructure should focus on improving the parts of the highway that are most used, and that is certainly the Učka tunnel and the rest of phase 2B2, because it is basically the only entrance to Istria, used by tourists.

All this leads to the conclusion that the construction of phase 2B2 is of strategic importance for the Istrian County, primarily due to its tourist importance. As tourism represents as much as 30% of Croatia's GDP, it is necessary to ensure that tourists come to Croatia using good infrastructure, especially motorways. Neighboring tourist countries such as Italy, Slovenia or Austria have done the same, so it is of great importance for the Republic of Croatia to invest

in increasing the level of quality of motorways in order to promote its tourism industry in the future.

1.6.4 Impact on GDP

The main idea is that investments, in general, have a positive impact on GDP, so investing in the construction of a new part of the highway also affects GDP. In order to show the impact of the construction of the Istrian Y on GDP, this paper will deal with the amount of investment each year compared to the GDP of the same year. The analysis of investments in new and existing sections of the motorway also includes the costs of extraordinary maintenance in all observed years. Calculation table below:

Table 6 - Share of investments in GDP

Year	Investments in new sections of MW (M HRK)	Investments in extraordinary maintenance (M HRK)	GDP (RH, M HRK)	Share of the Concessionaire's investments in GDP
2003	343,31	5,37	227.012,00	0,15%
2004	403,42	15,56	245.550,00	0,17%
2005	273,90	14,60	270.191,00	0,11%
2006	291,50	16,30	294.437,00	0,10%
2007	71,70	22,60	322.310,00	0,03%
2008	138,15	23,53	347.685,00	0,05%
2009	695,25	24,90	330.966,00	0,22%
2010	975,03	15,35	328.041,00	0,30%
2011	505,72	23,70	332.587,00	0,16%
2012	40,21	3,18	330.456,00	0,01%
2013	0,00	23,93	329.571,00	0,01%
2014	0,00	23,93	328.431,00	0,01%
2015	0,00	24,04	334.219,00	0,01%
2016	0,00	24,49	351.349,00	0,01%
2017	0,00	24,96	365.643,00	0,01%
2018	378,73	27,72	382.624,00	0,11%

2019	530,73	25,16	392.955,00	0,14%
2020	276,54	23,68	403.172,00	0,07%

Source: internal data, Bina-Istra d.d.

The largest share of construction of new sections of the Istrian Y in GDP is in 2010. In 2010, the most funds were invested for the commissioning of the section Umag - Kanfanar - Pula in 2011. From 2013 to 2018, the company did not invest in new sections, which means that only the costs of extraordinary maintenance were compared to GDP. The construction of the new section currently underway, Phase 2B1, will have a positive impact on GDP and the state budget.

As mentioned earlier, domestic companies are involved in the construction, which generate the first positive impact of the building on GDP. Another positive impact is, of course, safer and faster movement of people and goods, which will allow tourism to progress, which also has an impact on GDP. Let's not forget that tourism in Croatia makes up 30% of GDP.

Finally, the impact on the economy is reflected in the opening of industrial and business zones and large investments in the community with the aim of improving the road network by connecting local roads with motorways and facilitating the transport of goods from industrial zones and cities to other parts of Croatia and the European Union. Other components of GDP, such as consumption, also have a positive impact on GDP as the construction of sub-phase 2B2-1 will allow the employment of approximately 700 workers on the construction site who will earn their wages and be able to spend them in the market. Consequently, revenues from production and taxes, and finally GDP, will also increase.

1.6.5 Other positive influence

In this section, various impacts of the construction of subphase 2B2-1 that are not part of the previously mentioned categories are observed. One of the most important factors that have contributed to the development of tourist attractions in the Istrian County is the construction of the highway. Many destinations in Istria thus become even more accessible, and thus more attractive to tourists. Although the main reason for the construction of sub-phase 2B2-1 is not the development of tourist attractions, it is certainly an encouragement to investors in terms of easier and better accessibility of tourist locations. With this in mind, one can understand the

importance of subphase 2B2-1 for the further tourism development of the Istrian County, as it is part of the motorway used by most tourists coming to Istria.

It is expected that most tourists come to Istria primarily because of the sun and the sea, but in recent years Istria has established itself as a destination for enjoying top quality wine, olive oil and truffles, with many wine and oil routes. The wine and olive roads are different locations with numerous local wine and olive oil producers, open for tourist purposes. A total of 118 wine cellars and tasting rooms are offered on the wine road, while there are 160 olive growers and olive oil tasting rooms on the oil road. Also, in Istria there are about 100 bike trails with a total length of about 3,000 kilometers and 100 hiking trails with a total length of 1,000 kilometers, which can be used for running and hiking.

Gastronomic tourism is very important because of its year-round quality and resistance to seasonality. Also, in the off-season period, numerous festivals and events are held.

Apart from gastronomy, Istria is also a destination for health tourism, with thermal water springs it has become very attractive for weekend tourists. Furthermore, on the coast and in the interior of Istria, guests are offered a large number of dental, medical and rehabilitation institutions.

With the completion of the construction of a modern motorway and the reduction of travel time as in conditions of maximum safety, it is likely that visitors to Istria will use more such facilities.

2 CONCLUSION

The construction of the second bore of the Učka tunnel has significantly more positive effects and benefits compared to the financial costs of the project. The paper analyzed the main benefits of the project through several determinants such as: level of user safety, reduction of travel / waiting time, environmental protection, development of a comprehensive trans-European road network (TEN-T) and positive impacts on the local community and national economy. positive aspects.

The additional level of user safety that should be achieved by the construction of subphase 2B2-1 was considered through the number of accidents and accident costs per person, the safety of the Učka tunnel and the safety and productivity of infrastructure maintenance workers. The main focus was on the number of accidents and costs on the highway in full profile and on the highway in half profile. Statistics have shown that the total number of accidents has decreased in the analyzed years, but also that this number has been growing in recent years, as a result of a significant increase in traffic. The analysis of the number of traffic accidents per kilometer showed that the highway in full profile brings 0.61 accidents less per kilometer of the highway compared to the highway in the semi-profile. Also, the highway in full profile brings a drop of 8.15 accidents with injuries per year and a drop of 1.5 accidents with fatal outcome per year. Consequently, the construction of a full-profile highway would reduce the number of accidents with serious injuries by 106 as well as the number of fatal accidents (fatal accidents) by almost 25 by 2033.

In addition, the safety of the Učka tunnel, the safety of workers in the maintenance of infrastructure and the disruption of the normal flow of traffic were also observed. The safety analysis of the Učka tunnel was based on the European Commission Directive no. 2004/54 / EC on minimum safety requirements for tunnels in the TEN-T network, dated 29 April 2004, and clearly states the conclusion that the two-bore Učka tunnel, with one-way traffic flow in each tunnel bore, is needed as soon as possible. The safety of workers in the maintenance of infrastructure is reflected in the maintenance of the same or achieving an even higher level of productivity at work with less disruption of normal traffic flow and a greater degree of safety. The construction of an additional bore of the Učka tunnel and additional traffic lanes of the motorway will provide an additional level of safety for maintenance workers.

With the construction of the second bore of the Učka tunnel, the travel time will be shorter, but this calculation does not include all other benefits that the infrastructure user can look

forward to. The most important is certainly the previously mentioned number of accidents, which is significantly lower on the highway in full profile compared to the highway in full profile. This work showed that the construction of an additional pavement with two traffic lanes will allow faster passage through the tunnel, with the creation of significantly smaller queues at the toll station of the tunnel, which ultimately leads to a shortening of waiting time.

Impacts on environmental protection dealt specifically with the topics of closed drainage system, water protection and animal protection. Water protection and a closed drainage system are aimed at various ways of controlled water collection in order to ensure a system that will guarantee the safety of users but also that will not disturb the ecosystem of the area through which this section of the highway passes.

The positive impacts of the project on the European Union have been observed through the upgrade of the comprehensive trans-European road network (TEN-T). In general, the network is divided into a core network and a comprehensive network. The core network is linked to the capitals, and the comprehensive network is linked to all other infrastructural locations on the network that are important for the development and better connectivity of the regions in the European Union.

The core network will be completed by 2030 and comprehensive by 2050. Subphase 2B2-1 is part of a comprehensive network that includes airports and seaports in the Republic of Croatia. Due to the development of tourism, it is necessary that they are better interconnected, but also, due to regional development, better connected with the rest of the Republic of Croatia. Subphase 2B2-1, which is located on the comprehensive TEN-T network, will connect Istria with the rest of Croatia and will enable users to continuously use the TEN-T network, easier transport of goods and to easily reach Istria from other regions of Croatia.

The impact on the economy as a whole was observed through the potential of opening economic zones and business areas. The positive impact of large investments in construction with the aim of improving the road network also affects the connection of local roads with the highway in full profile and ensuring and improving the flow and transport of goods to the rest of the Republic of Croatia and the European Union.

An important impact, which needs to be mentioned, includes the impact on improving the employment of people from the local community. The positive impact on tourism is obvious, with the Istrian motorway being primarily a tourist motorway. The growth of tourist arrivals over the years has been accompanied by the opening of certain sections of the Istrian Y. It is

important to note that 95% of tourists who come to Istria come by car. All this is accompanied by an increase in income.

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List of Tables

List of Charts

List of Pictures