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Editor's note

Dear Readers,

Before you is a new issue of our professional supplement "Stručne teme iz područja prometa i logistike" (Applied Research Topics in Transport and Logistics), a bilingual publication issued alongside the influential scientific journal Promet – Traffic&Transportation.

The professional supplement "Stručne teme iz područja prometa i logistike" (Applied Research Topics in Transport and Logistics) addresses topics targeted at stakeholder groups within the transport and logistics sector. It has been conceived and published primarily to foster communication and synergy between science and industry, with a focus on bringing scientific practices and achievements closer to the business community and presenting them in an accessible and relevant manner.

This issue is dedicated to railways in the Republic of Croatia and in Europe – a system that is more than infrastructure, more than transport, and more than a daily headline about delays or new investments. Railways are the lifeblood of space, a witness to history, and a reflection of our capacity to plan, connect and develop in the long term.

At a time when transport policies are increasingly directed towards sustainability, energy efficiency and emission reduction, rail is once again taking centre stage in strategic thinking. European corridors, railway modernisation, the introduction of new trains and the digitalisation of traffic management are not merely technical projects – they are prerequisites for balanced regional development, a competitive economy and an improved quality of life for citizens.

In this issue, subtitled "Two Centuries of Railways in the World", we present an interview with Prof. Borna Abramović, Ph.D., author of the extensive monograph of the same title, with particular attention devoted to the historical heritage of railways in the Republic of Croatia. The Ministry of the Sea, Transport and Infrastructure and the Croatian Employers' Association provide their perspectives on the development and liberalisation of the railway system, while Končar presents its new electric trains. Finally, Sebastian Belz, Secretary General of the European Platform of Transport Sciences (EPTS), offers his view on railway development at the European and EU levels.

We are aware that railways in the Republic of Croatia are undergoing a period of intensive change. Some developments are already visible on the ground, others remain in the planning phase, and yet others await political and financial confirmation. One thing, however, is certain – without a strong, reliable and modern railway network, there can be no serious transport system in the 21st century.

Predrag Brlek, Managing Editor

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TWO CENTURIES of Railway in the World

Prof. Borna Abramović , Ph.D.
Full Professor,
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On the occasion of the publication of the monograph "Two Centuries of Railway in the World: Two Centuries from the First Plan to Today's Railway Network in Croatia", we spoke with prof. dr. sc. Borna Abramović, Head of the Department of Railway Transport at the University of Zagreb, Faculty of Transport and Traffic Sciences. In addition to the main topic, we also asked him several questions related to his "life theme" – the railway.

How did the idea for writing the monograph "Two Centuries of Railways in the World: Two Centuries from the First Plan to Today's Railway Network in Croatia" come about?

For more than twenty years, I have been actively cooperating with colleagues from the Croatian Railway Museum, which operates within HŽ Infrastruktura d.o.o. A major anniversary was approaching, and in 2023, we agreed that we should prepare a scientific monograph on two centuries of railways in the world. Railways enabled the modernisation of states, accelerated industrialisation, shaped cities, defined migration and travel patterns, changed our perception of space and time, and significantly contributed to the speed of exchanging ideas. The birthday of the railway is 27 September, when the father of the railway, George Stephenson, placed a yellow carriage marked "Experiment" at the end of a black freight train and began transporting people on the legendary Stockton–Darlington line. When considering how to present the material, dr. sc. Josip Kajinić and I decided to follow railway history decade by decade, presenting developments at the global level in parallel with those in Croatia. In each decade, we described the most significant events, not only technical aspects, but also technology, organisation, legislation, transport policy, and perhaps most importantly, railway women and railway men. Once the manuscript was completed, we found suitable reviewers: prof. dr. sc. Tomislav Josip Mlinarić (University of Zagreb, Faculty of Transport and Traffic Sciences), dr. sc. Slaven Gašparović, Associate Prof. (University of Zagreb, Faculty of Science, Department of Geography) and dr. sc. Josip Mihaljević, Assistant prof. (Croatian Institute of History). Their comments and advice significantly improved the quality of the monograph.

Budapest's Nyugati (Western) Station
Foto: Borna Abramović

How difficult was it to collect such extensive material for the book?

We intensively collected various materials for a year and a half. We contacted, by email and telephone, railway museums around the world, cultural centres of different countries in Croatia, embassies of countries with railway systems, various forums, publishers, railway enthusiasts and railway professionals. When we compiled the acknowledgements list, we stopped at the number 637. That figure, 637 legal and natural persons, illustrates how complex and time-consuming it was to gather high-quality material for a scientific monograph. Additionally, given the bicentenary of the railway, we limited ourselves to 200 pages.

Where does your love of railways come from? Did it start at university or earlier?

As the saying goes, "Blood is thicker than water". My great-grandfathers on both my mother's and father's sides were railway workers, so I grew up in a family always surrounded by railway people and railway topics. In primary school, we visited the Technical Museum in Zagreb, where a railway modelling exhibition was being held. That was the final event that determined that railways would be my life. I later enrolled at the Railway Technical School in Zagreb and afterwards at our Faculty, of course choosing the railway specialisation.

You travel by train for most of your journeys. How much more difficult or easier is it to organise compared to driving? Do you know how many kilometres you have travelled by train in your life?

Yes, only where it is physically impossible to reach by train do I use an aeroplane. I believe I must lead by example and show how practical and simple railway travel can be. It may not always be the fastest option, but it certainly brings us safely and comfortably to our destination.

Over the past ten years, I have purchased all my train journeys from the comfort of my home, using various online platforms of different railway operators. I would say it is easier to board a train and head towards your destination than to choose a car. After four or five hours, whether we admit it or not, the driver becomes tired, and driving becomes a burden rather than a pleasure.

Honestly, I do not know how many kilometres I have travelled by train, but I can mention some destinations I have reached by rail: Lisbon, London, Newcastle upon Tyne, Copenhagen, Vilnius, Kharkiv, Kyiv, Sevastopol, Palermo, Ankara and thousands of other cities. I have also visited the highest railway station in Europe, Jungfraujoch (3,454 metres above sea level); travelled through the world's longest railway tunnel, the 57-kilometre Gotthard Base Tunnel; ridden Europe's fastest train between Paris and Strasbourg at 330 km/h; and travelled on the slowest "express" train in the world, the Glacier Express, with an average speed of just 40 km/h.

What are the main differences between passenger rail transport in Croatia and in developed countries?

In my first lectures on the course "Organisation of Railway Transport", I state: "The railway reflects the state." The best example is the railway station – it is the gateway to the railway system. Over the past two centuries, stations were rightly described as cathedral-like. When arriving at Paris Gare de Lyon, Vienna's main station (only about ten years old), or Zagreb Main Station, one can immediately perceive the quality of railway service.

Over the past fifty years, Croatia experienced an excellent railway system, with high-quality business train services connecting major centres. In 1982, a Končar-built locomotive reached 183.7 km/h, making Croatia the fifth country in the world to operate at speeds above 160 km/h. The Novska–Vinkovci–state border line was modernised for 160 km/h, and the famous Sava Express ran between Belgrade and Zagreb in just four hours.

Unfortunately, in the 1990s, motorway construction expanded strongly and uncontrollably, although the Transport Development Strategy of the Republic of Croatia envisaged balanced development of all transport modes to preserve the economy.

Over the past ten years, efforts have been made to restore the railway's former glory, but as readers can see, the process is very slow.

Since we are speaking about stations, could you highlight some of your favourites?

A railway station is usually located in the city centre. After leaving the train, walking along the platform and through the concourse, a passenger sees – and perhaps for the first time truly feels – the new city and its pulse. In the past, stations were called modern cathedrals for good reason. A prime example is Zagreb Main Station, from which one steps directly onto one of the most beautiful squares, dominated by the statue of King Tomislav.

Having visited many stations, each has its own local and global story. I would highlight Sirkeci Station in Istanbul, just steps from the Bosporus, where the Orient Express began its journey – passing through Croatia and immortalised by Agatha Christie. I would also mention Budapest's Nyugati (Western) Station, designed and built by Gustav Eiffel; České Budějovice station, the railway hub of southern Bohemia; Ospizio Bernina in central Europe at 2,253 metres above sea level, where the train stops only on request; and, certainly among my top five, Paris Gare de Lyon with its magnificent clock tower and the Le Train Bleu restaurant, once a departure point of the Orient Express towards the east, linking Paris and Zagreb with sleeping cars.

Gare De Lyon Station ,Paris
Foto: Borna Abramović

Ospizio Bernina Station
Foto: Borna Abramović

What should Croatia do to approach that level of development?

As I mentioned, over the past ten years we have moved from a standstill, but the process remains slow.

There is funding available for the railway system; it simply needs to be used wisely.

There is light at the end of the tunnel.

The first and most important step is for politics, through actions rather than words, to fully commit to the development of the railway transport system. Administrative obstacles to development must not occur.

In the next four years alone, 1.5 billion EUR has been secured for railway vehicles and 2.5 billion EUR for railway lines. We must act wisely and spend this hard-earned money carefully.

My vision is that in ten years we will see trains reaching Split in four hours, Rijeka in two hours, Slavonski Brod in one and a half hours, Vinkovci in two hours and Osijek in around three hours. We do not need to run at 300 km/h – 200 km/h would be quite sufficient.. ●

České Budějovice Station
Foto: Borna Abramović

02

DEVELOPMENT OF THE RAILWAY IN THE REPUBLIC OF CROATIA - Yesterday, Today, Tomorrow

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Ministry of the Sea, Transport and Infrastrucure

At the time of writing this article, in early 2026, it is almost impossible to overlook the important anniversaries marked during 2025 – 200 years of railways in the world and 165 years of railways in Croatia – which naturally serve as a starting point for understanding today's challenges and directions of development. In 2025, 200 years were commemorated since the event that permanently changed the world of transport: the first public steam-hauled train journey between Stockton and Darlington on 27 September 1825. On that day, people gathered on foot, on horseback and in carriages to witness something previously unimaginable – travelling by train along the "iron road". The steam locomotive, which many called the "iron horse", marked the beginning of the modern era of passenger and freight transport. The development of the railway was not an instant invention-driven revolution, but rather the result of a long series of experiments, technical improvements and engineering solutions. The name of George Stephenson remains permanently associated with this beginning, yet behind the first railway line stood visionaries, entrepreneurs and investors who recognised the potential of the new technology to transform the economy and everyday life. The railway very quickly became a driver of industrial development, urban connectivity and market expansion. One of the more interesting consequences of its development was the change in the perception of time. Until then, time had been measured locally, according to the position of the sun, but railway timetables required precise synchronisation. In doing so, the railway encouraged the gradual introduction of standard time, first in Great Britain and then throughout the rest of the world. Only 35 years after that historic event, the railway reached the territory of present-day Croatia. In 1860, the first railway line was opened, linking Nagykanizsa via Kotoriba and Čakovec with Pragersko in Slovenia. Thus, in 2025, Croatia marked 165 years of railways. The approximately 42-kilometre section was built almost entirely in a straight alignment, with very gentle gradients, requiring the construction of only two major bridges over the Drava and Mura rivers. With the construction of this line, Croatia joined the main European transport flows as early as the 19th century, establishing a direct link to the Vienna–Trieste route and soon afterwards to Budapest. Although due to the then administrative status of Međimurje, it was often regarded as a peripheral section, the line was of great importance for the development of local communities, trade and territorial connectivity. The beginnings of the railway, both globally and in Croatia, demonstrate that it was never merely a technical achievement, but a social transformation that shortened distances, changed lifestyles and opened up new development opportunities. From the "iron horse" of the 19th century to modern electric and

Foto: Ante Klečina

digitally controlled trains, the fundamental idea has remained the same – to connect people, regions and economies.

It is upon these historical foundations that the contemporary concept of the railway in the Republic of Croatia is being built today, linking the modernisation of infrastructure, systems and rolling stock with the goals of sustainable mobility and stronger spatial connectivity. Particular attention is being paid to the main corridors connecting the country's interior with ports and international transport routes, thereby strengthening Croatia's transport and economic integration with the European market. One of the key elements of this development direction is the project of the new Zagreb–Rijeka lowland railway line, considered the most significant infrastructure undertaking in the Croatian railway system in the coming decades. Its objective is to shorten travel times between the continental and coastal parts of the country and to enable more efficient freight and passenger transport, particularly in connecting the Port of Rijeka with European transport networks. The scale of current investment can be illustrated by specific data. Between 2017 and 2025, approximately 1.5 billion EUR was invested in the renewal and modernisation of railway infrastructure, while 70 new low-floor trains were introduced into service, 42 of them within the last four and a half years, representing the largest rolling stock renewal programme in the history of Croatian railways. By the end of 2028, a total of 89 new trains are planned to be in operation, and passenger numbers have increased to around 26 million annually. Modern railway modernisation is not reflected solely in infrastructure renewal and the procurement of new trains, but also in a change in the way travel is experienced. The new trains are equipped with digital systems, wireless internet and ergonomic spaces for work and study, increasingly transforming time spent on board into a productive part of everyday life. In this way, the railway adapts to contemporary lifestyles while simultaneously shaping them, just as it did in its historical beginnings. A particular breakthrough is represented by the introduction of trains powered by alternative propulsion systems, including battery and hybrid technologies, enabling operation on non-electrified lines without the use of diesel locomotives. In this way, the circle is symbolically closed – from the steam "iron horse" of the 19th century to the quiet and energy-efficient trains of the 21st century.

The development of the railway in the Republic of Croatia today cannot be viewed outside the European framework. Rail transport has become one of the key areas of the European Union's common transport policy, particularly in the context of climate objectives, sustainable mobility and strengthening cross-border connectivity. One of the fundamental objectives of European transport policy is the creation of a

Single European Railway Area, implying technical and organisational harmonisation of systems and the removal of cross-border barriers. Train travel between Member States is gradually becoming simpler and more reliable, thereby strengthening connectivity between European regions. A special role in this process is played by the Trans-European Transport Network (TEN-T), which links major European cities, ports and logistics hubs. Croatia, located at the intersection of Central European and Mediterranean regions, plays an important role in connecting the Adriatic with the European hinterland, particularly through the modernisation of railway routes towards the Port of Rijeka and their integration into European transport corridors. The European Union has also provided a very concrete strategic direction for railway development: by 2030, at least 30% of freight transport is to be shifted from road to rail, and by 2050, as much as 50%. In this way, rail is reaffirmed as the principal carrier of medium- and long-distance transport, while simultaneously reducing the negative environmental impacts of traffic. Strong emphasis is also placed on innovation and digitalisation. The introduction of common technical standards, such as the European Rail Traffic Management System (ERTMS), enables safer and more efficient functioning of the railway network at the continental level. At the same time, many European countries are witnessing the revival of international passenger services and night trains, offering an alternative to air transport on medium-distance routes. Within this framework, railway development in Croatia is increasingly being integrated into the common European transport area, in which national systems are gradually interconnected and technically harmonised, creating the foundations for safer, more sustainable and more competitive rail transport.

The development of the railway system depends not only on infrastructure and strategic documents, but also on technological solutions that enable their implementation in everyday operations. Industry plays an important role in this process, and for Croatia, domestic railway vehicle manufacturing is of particular significance. Končar – Electric Vehicles (KEV) stands out as one of the key drivers of modern train development. In recent years, new generations of low-floor electric multiple units and diesel multiple units have been developed within domestic production, tailored to the needs of contemporary passenger transport. Emphasis is placed on energy efficiency, reduced noise and emissions, and greater passenger comfort, gradually bringing rail travel closer to the standards of developed European countries. A particularly significant milestone was achieved with the introduction into service of the first battery-powered train manufactured in Croatia, developed by Končar – Electric Vehicles. This train has a maximum speed of up to 120 km/h, a capacity of more than 200 passengers, and the ability to operate for over 200 kilometres on a single battery charge. It is intended for operation on non-electrified lines without the use of diesel traction. This has opened up new possibilities for the modernisation of regional and local transport with significantly lower environmental impact. An important part of this process is cooperation between industry, academia and professional institutions, linking scientific research, engineering expertise and practical application to create solutions tailored to national needs while aligned with European technological trends. Just as the steam locomotive represented a technological breakthrough in the 19th century, today's development of battery-powered and digitally controlled trains marks a new turning point in the evolution of rail transport. In this contemporary wave of innovation,

Foto: Ante Klečina

domestic industry participates in the European transition towards cleaner, quieter and more energy-efficient modes of transport, linking national development projects with the objectives of sustainable mobility in the 21st century.

The modern railway is shaped not only through infrastructure and vehicles, but also through the way in which the entire transport system is organised. Alongside technological modernisation, the institutional and market framework in which rail operates is also evolving, opening a new chapter in the development of rail transport in the Republic of Croatia. The development of the railway system in Croatia is

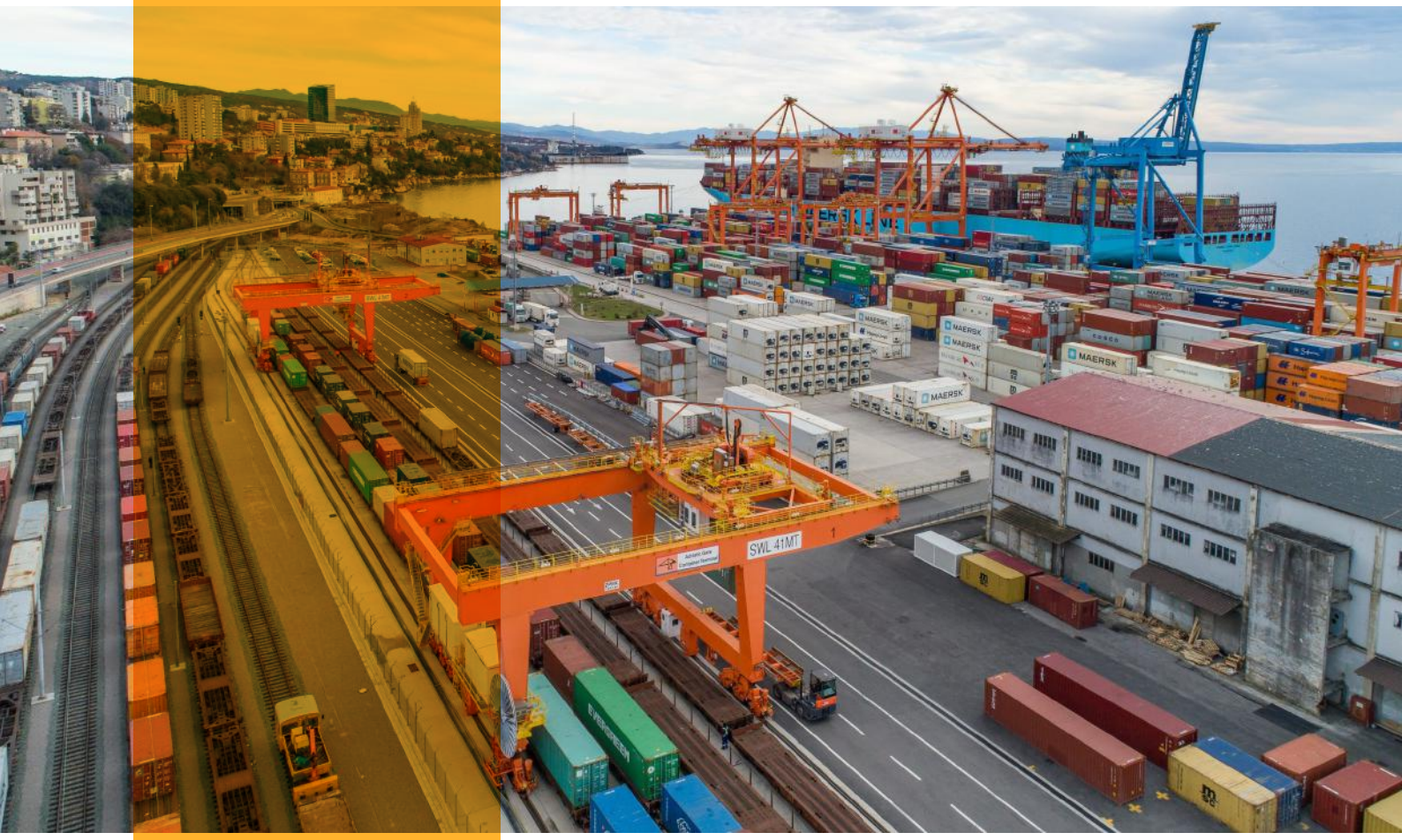

Foto: HŽ Infrastruktura d.o.o.

thus taking place in parallel with the gradual opening of the rail transport market, in line with the European regulatory framework. Market liberalisation entails creating conditions for the operation of multiple railway undertakings, strengthening competition and encouraging greater efficiency and quality of service for users. For passengers, this process does not represent an abstract regulatory model, but potentially greater choice, more diverse services and improved regional connectivity. In this sense, liberalisation complements the broader trend of adapting rail transport to contemporary mobility needs, with increasing emphasis on accessibility, reliability and quality of travel. Market opening is particularly significant in the context of cross-border transport, where system interoperability and common European standards facilitate the integration of national operators into wider transport flows. In many European countries, liberalisation has already encouraged the return of international passenger services and night trains, offering a sustainable alternative to air transport on medium-distance routes and once again connecting major European cities by rail. At the same time, liberalisation requires a stable regulatory framework ensuring equal conditions for all participants, a high level of safety and the protection of passenger rights. Market development is therefore viewed not solely from an economic perspective, but also as part of the social responsibility of the transport system, in which public interest and market principles complement one another. Market liberalisation thus represents the final stage of the contemporary transformation of the railway – from the historical "iron horse" of the 19th century to an open and European-integrated transport system of the 21st century.

When the first steam train set off along the "iron road" in 1825, few could have foreseen that this invention would change not only the way people travel, but the way they live. Two hundred years later, the railway is once again undergoing a profound transformation – this time towards sustainability, digitalisation and European connectivity. Croatian railways today are developing on the foundations of a rich history, yet with a clear view towards the future. From historic lines to new infrastructure projects, from the steam "iron horse" to battery-powered and digital trains, the same idea remains unchanged: to connect people, regions and economies. In this lies the enduring strength of the railway as a transport system that belongs not only to the past, but also to the future.. ●

03

Smarter, Greener and Connected – A New Era of Urban Mobility by KONČAR

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KONČAR d.d.

The KONČAR Group is one of the largest and most technologically advanced industrial systems in South-East Europe. Within the Group, KONČAR – Electric Vehicles serves as a strategic development centre specialising in the development, design and manufacture of modern, innovative railway vehicles. As a boutique manufacturer of high-quality, tailor-made solutions, the company – with more than half a century of tradition – continuously pushes the boundaries of technology, sustainability and design. Today, KONČAR – Electric Vehicles connects a broad network of domestic technological and manufacturing partners, creating products with high added value. The KONČAR Group employs more than 6,000 experts, over 400 of whom work in Electric Vehicles. Multidisciplinary teams cover all stages of development – from concept and design, through manufacturing, to testing and maintenance. Such synergy within the Group guarantees solutions aligned with the highest European standards.

Innovation at the core of the production portfolio

KONČAR – Electric Vehicles designs, manufactures and homologates a range of next-generation vehicles:

- Low-floor electric multiple units and diesel multiple units (EMU, DMU)
- Next-generation battery trains (BMU, BEMU)
- Bimodal electro-diesel multiple units (EDMU)
- Low-floor trams
- Special-purpose vehicles, such as fully equipped measurement trains

In addition to new products, the company is engaged in the modernisation and long-term maintenance of locomotives and existing trains, ensuring high reliability and optimal system performance for its customers.

Next-generation battery trains

The BEMU combines electric traction from the overhead contact line with powerful battery storage systems, enabling seamless transition from electrified to non-electrified sections – an ideal solution for the Croatian network, where a significant proportion of lines remain non-electrified.

Key performance characteristics::

- Up to 480 km daily mileage
- Up to 18 hours of operation
- 120 km/h in battery mode

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- 160 km/h on electrified lines
- Charging via the overhead network or stationary charging stations

KONČAR's BMU is currently the only multi-car battery train operating in regular commercial service in Europe. Designed for non-electrified lines, it reaches a speed of 120 km/h and, while its standard range is 100 km, under optimal conditions, it can achieve up to 200 km..

Both trains are equipped with wheelchair ramps, bicycle spaces and fully accessible toilets. Passenger areas feature CCTV surveillance, modern passenger information systems, air conditioning and free Wi-Fi.

A particular advantage lies in their mutual compatibility – the BEMU and BMU can be coupled with the new generation of low-floor trains, enabling operators to flexibly increase capacity.

1 MW battery charging infrastructure

KONČAR has developed and commissioned 1 MW charging stations with a charging time of just 27 minutes. Six units are already in operation, with additional installations planned shortly, positioning Croatia among the first European countries with such advanced railway battery infrastructure. With their flexibility, energy efficiency and high share of domestic industry involvement, the BMU and BEMU represent some of the most advanced trains in their category globally

Trams – Croatian design for Croatian cities

For more than 20 years, modular KONČAR trams have operated on the streets of Zagreb, and a new generation of fully low-floor models has recently been introduced. Reliable, economical and adapted to the needs of modern urban transport, these trams have accumulated hundreds of millions of kilometres in service.

Looking ahead – EDMU and a new philosophy of mobility

Building on its experience in battery technologies, KONČAR will present the EDMU – a new bimodal electro-diesel multiple unit for long-distance transport – at the InnoTrans trade fair in Berlin this year. The combination of diesel and electric traction, together with the possibility of subsequent modernisation, makes it an ideal solution for the transitional period towards full decarbonisation.

The development of the EDMU confirms the strategic direction of the KONČAR Group: creating a fleet of vehicles capable of meeting market demands for more sustainable and energy-efficient mobility. Through strong strategic investments, effective cooperation within the Group and a focus on sustainable solutions, KONČAR reinforces its position as one of Europe's key innovators in the field of urban and regional mobility. ●

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04

Liberalisation of the Railway Market in Croatia: The Perspective of Private Operators, Effects and Bottlenecks Reducing Competitiveness

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The liberalisation of the railway market in the European Union is based on non-discriminatory access to infrastructure and the promotion of competition with a view to increasing efficiency, service quality and achieving a modal shift towards rail. In Croatia, liberalisation is most visible in the freight segment, where the market share of new operators has grown, while passenger transport in practice remains predominantly reliant on a single operator. This paper examines liberalisation from the perspective of private freight operators: the benefits achieved through more transparent market access and the professionalisation of services, as well as the limitations arising from infrastructure conditions, prolonged engineering works, capacity unpredictability and staffing challenges. The final section proposes measures to ensure that liberalisation remains sustainable during a period of significant investment activity: improved capacity management, clear compensation mechanisms during infrastructure works, and strengthened cross-border coordination and competence standards.

Keywords: lliberalisation; private railway undertakings; freight transport; capacity management; infrastructure; compensation; green transition. infrastruktura; kompenzacije; zelena tranzicija.

1. Introduction

The liberalisation of the railway market entails opening access to infrastructure to a greater number of railway undertakings, alongside the separation of the roles of infrastructure manager and operator. Within the European Union, this model has been implemented with the aim of strengthening competition and service quality, while safeguarding safety and ensuring equal access. In the Croatian context, liberalisation is taking place in a demanding environment: the railway network extends over 2,617 km, of which 1,013 km are electrified, while

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double-track lines account for approximately 276 km. The main corridors carry the largest share of traffic; therefore, reliability, speed and available capacity on these sections are decisive for the competitiveness of rail transport.

For private (and new) freight operators, liberalisation is not merely a regulatory change, but also a shift in business risk. Investments in rolling stock, personnel and customer contracts are viable only if network access conditions are predictable and capacity is available within timeframes compatible with logistics chains. Consequently, the effects of liberalisation are most realistically assessed through the experience of operators active on the market, who bear the direct consequences of disruptions, engineering works and cross-border constraints.

2. Market structure and traffic volume

According to data from the regulator, 18 freight and 2 passenger railway undertakings are registered in Croatia; however, in passenger transport during 2024, services were provided exclusively by HŽ Putnički prijevoz (HŽPP). Liberalisation has nevertheless significantly transformed the freight segment: in 2024, new operators accounted for 59.6% of the market in terms of tonnes transported, while HŽ Cargo held a 40.4% share.

At the same time, the absolute volume of rail traffic remains limited in relation to the ambitions of the green transition: in 2024, 14.7 million tonnes of freight were transported (3.3 billion tonne-kilometres), along with 21.9 million passengers (927 million passenger-kilometres). In practice, this means that competition in freight transport exists, but network quality and capacity availability are decisive factors – often more important than the transport price itself, particularly when customers compare alternative routes, ports and modes of transport.

3. Liberalisation from the perspective of private operators

On a liberalised market, private freight railway undertakings most commonly operate as part of a broader logistics chain (industry – terminal/port – international corridor). Their competitiveness is based on reliability and speed of delivery, the quality of operational information (engineering works, restrictions, path availability), interoperability and the ability to manage cross-border flows. The following section outlines the most significant positive and negative effects of liberalisation in practice, precisely from this operational and business perspective.

3.1. Positive effects of liberalisation in practice

The positive effects of liberalisation are most visible in freight transport and may be summarised as follows:

- more open and transparent market – the introduction of competition increases transparency in pricing and in the conditions for access to the network and service facilities, as well as comparability of offers among multiple providers.
- Diversification of operators – more combinations within the chain – a greater number of railway undertakings multiplies the possibilities for combining train paths, capacity, shunting services and intermodal connections (port – rail – inland), thereby increasing the resilience and flexibility of logistics chains.
- Acceleration and professionalisation of processes – the time from enquiry to operation is reduced, ad hoc path requests are processed more quickly, and digital channels are expanding (standardised SLAs, electronic data interchange, timely information on network restrictions).
- Transformation of the legacy system – the de facto monopoly model is gradually becoming more customer-oriented; the focus is shifting towards punctuality, reliability, productivity and service quality.
- Tangible benefits for customers – customers gain more options and greater bargaining power, as well as services better tailored to their needs; the overall logistics cost (TCO) is reduced primarily through reliability and more stable delivery times, rather than solely through a lower price per tonne-kilometre.
- Investment and innovation – private operators are more likely to introduce modern rolling stock, telematics and planning tools, and to implement interoperable solutions more rapidly (e.g. ERTMS-ready equipment, systems compliant with TAF TSI).
- Growth of intermodality and cross-border

connectivity – better utilisation of ports and terminals, along with easier configuration of international flows (TEN-T), encourages a shift of freight from road to rail along regional and pan-European corridors.
- Benchmarking and safety culture – competition necessitates performance measurement (punctuality, damage rates, dwell times), which enhances operational discipline, standardises procedures and indirectly strengthens safety and quality.
- Sustainability and climate objectives – a competitive market facilitates a modal shift towards rail (lower emissions per tonne-kilometre) and accelerates the achievement of climate objectives for both customers and the state.
- Development of sectoral competences – new professional profiles are emerging (dispatchers, capacity planners, data analysts) and specialisation is encouraged; however, without common standards for training, licensing and mentoring, an increased workforce does not necessarily translate into improved service quality.
- Improved risk management – diversification of service providers reduces dependence on a single operator and, in times of disruption (engineering works, interruptions on neighbouring networks), facilitates the rerouting of flows and the preservation of service continuity.

3.2. Negative effects and risks of liberalisation in practice

In the Croatian case, the negative effects of liberalisation are largely linked to infrastructure, capacity management and the implementation of engineering works, as well as to market and staffing risks:

- Infrastructure condition and maintenance – higher overall gross tonnage and a more diverse rolling stock fleet (different axle loads, braking systems and wheel profiles) accelerate wear of track, switches and level crossings; with more operators, the coordination of works and maintenance becomes more complex.
- Congestion and service disruptions – liberalisation has accelerated traffic growth, but without synchronised investment in the network and tools for joint planning among multiple operators, the system becomes more congested, with longer disruptions and more difficult organisation of works.
- Infrastructure as a single bottleneck – all operators depend on the same network; prolonged engineering works without effective capacity management may lead to productivity losses (waiting times, diversionary routes, loss of train paths) and loss of market share, particularly for private operators operating on thin margins.
- Staffing challenges – the market has become more competitive and professionalised, yet the workforce has not expanded at the same pace. Rapid retraining programmes sometimes outpace the actual requirements of the job, resulting in "patchwork" competences and increased operational risk. Without common standards for training, licensing and mentoring, a larger workforce does not automatically translate into higher service quality.

Foto: Ante Klečina

4. Investment cycle and responsibility for managing the transitional period

The modernisation of the Croatian railway network is essential, and the investment framework is ambitious:

- The National Railway Infrastructure Development Plan 2022–2030 provides for a total investment of EUR 4.03 billion (EUR 2.19 billion from EU funds, EUR 1.52 billion from the state budget, EUR 251 million from loans and EUR 62 million from other sources).
- The 2022–2024 Action Plan allocates EUR 1.02 billion.
- In 2024, HŽ Infrastruktura implemented EUR 251 million in investments (59.5% financed through EU projects).
- The Railway System Revitalisation Project of the Republic of Croatia includes a European Investment Bank (EIB) loan of EUR 900 million (EUR 700 million for infrastructure and EUR 200 million for new trains).

These figures demonstrate a strong development ambition, but at the same time raise a crucial question: how to preserve market competitiveness and retain customers on rail during a period of intensive engineering works. From the perspective of private operators, the transitional period represents the riskiest phase of reform – since operational reliability declines precisely at a time when traffic growth and modal shift are expected.

5. Disruptions, loss of competitiveness and compensation mechanisms

Prolonged engineering works causing speed restrictions and line closures generate losses for railway undertakings at four levels: time, capacity, cost and market share. Unlike road transport, diversionary rail routes depend on interoperability, authorisations and international operating regimes, which further complicates the situation. In such circumstances, the market alone cannot offset the damage incurred, as customers opt for faster and more reliable routes or alternative modes of transport. It should also be taken into account that the Croatian rail transport market is not yet fully liberalised, as the state continues to provide significant support to the incumbent operator, which may affect the level playing field.

In Croatia, certain compensation measures are formally envisaged (charges applicable only to operated trains, non-charging of unused capacity due to works, compensation for stabling). However, in practice, these measures provide limited relief to operators. At the initiative of railway undertakings, a model of compensation measures is being developed, which the Ministry of the Sea, Transport and Infrastructure, in cooperation with the Faculty of Transport and Traffic Sciences, plans to implement. It is essential that such measures be predictable, measurable and legally grounded, in order to avoid ad hoc interventions and distortions of competition.

6. The Slovenian framework as an example of good practice

Slovenia combines direct incentives for freight transport with compensation for disruption caused by engineering works. Performance-based incentives amounted to EUR 15 million for 2022 and 2023 and were extended to cover 2024–2025. Compensation for costs incurred due to engineering works totals EUR 18.27 million for 2024. A transparent and pre-defined framework enables market participants to recover part of their additional costs or loss of efficiency, thereby avoiding the economic "penalisation" of those who invest and assume market risk in a liberalised system.

For Croatia, the key lesson is that during periods of extensive works, reliance on improvised measures should be avoided. Instead, a compensation and incentive programme should be established that is technologically and ownership-neutral, with clear rules for demonstrating costs and performance, and with coordination between the infrastructure manager and the regulator.

7. Conclusion and recommendations

In Croatia, liberalisation has increased competition in the freight segment and shifted market shares towards new operators. From the perspective of private undertakings, the principal advantages are greater transparency, professionalisation and more flexible configuration of logistics services. However, without reliable infrastructure and an effective capacity management policy, liberalisation may remain merely formal – while being operationally disadvantageous, particularly during prolonged engineering works.

In order for liberalisation to become a genuine mechanism for strengthening rail and achieving modal shift, the following is recommended::

- Strengthening planning and capacity management during engineering works, with timely and standardised information provided to all operators;
- ▪ Introducing predictable compensation mechanisms during works, drawing on best regional practice, with clear evidentiary rules and non-discriminatory access;
- ▪ Systematically addressing workforce shortages through training standards, licensing and mentoring, while promoting transferable competences within the sector;
- ▪ Enhancing cross-border coordination (engineering works, operating regimes, capacity) to ensure that international flows are more stable and competitive

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05

STRATEGY for the Development of the European Railways - A European User Perpective

Sebastian Beltz
European Platform of Transport Sciences e.V. (EPTS)

The European Commission assigned the year 2021 as the "European Year of Railways". For the first time in history, the Commission dedicated an entire year to one specific transport mode, for the reason of developing a sustainable, peaceful and prosperous environment for the European continent. With this statement, the EU representatives also acknowledged that, next to the long-lasting programs, like the TEN-T-Network program or Shift2Rail, more had to be done to create an integrated rail-based transport system that would be able to serve as the "backbone of European mobility" (Ursula von der Leyen) one day. Rail would have to enter the hearts of the European citizens, too.

A great many conferences, congresses and excursions were organised during that year, not only by the European Union, but equally by their member and neighbouring countries and regions. The most outstanding and widely renowned event of all these was, for sure, the Connecting Europe Express, a train organised by the EU, composed of 6–8 carriages and locomotives from diverse European origins, that

In September 2021, the Connecting Europe Express reached the Polish border station of Trakiszki on its way to Kaunas. It is the very first passenger service crossing to Lithuania in over a year, due to the pandemic. The young Polish train manager (right) hands over the train responsibility to his experienced Lithuanian colleague (left). The Austrian sleeping car's train guard in the middle completes this iconic picture of European Railwaymen's collaboration
Foto: Sebastian Beltz

Liège in Western Belgium (200.000 inhabitants) is one of the smallest European cities that is served by two competing high-speed rail operators. Every two hours, Eurostar operates services from Dortmund or Cologne in Germany to Paris in France. In the alternate hours, Deutsche Bahn runs services from Frankfurt in Germany to Brussels in Belgium, connecting Europe's financial and political centres. A DB Class 407 train set has a short stop beneath the impressive roof of Liège-Guillemins station, designed by Spanish star architect Santiago Calatrava. The entire Belgian high-speed line from the French to the German border is built for speeds up to 260–300 km/h.. Foto: Sebastian Beltz

travelled through 26 different European countries within five weeks in the summer and autumn of 2021. It was designed as a statement of the capability and the unity of railways. Every citizen was literally invited to hop on that train and experience what an integrated European approach to railways looks like. The Connecting Europe Express was the ideal projection for what the vision of a joint European Railway Network actually means.

Of course, all stakeholders were aware that such symbolism needs to be mirrored by long-term plans and concepts with respect to legislation, political commitments and financial backups. It is only possible to succeed in such a shift towards another transport mode in the real world if everybody is in line with the core idea. European railways do need much more than just one "Year of Railways". They will require this support and awareness for the upcoming decades. Without doubt, this homogeneous long-term action is the most fragile element of the vision: we know what to do, how to do it and even how to finance it. But will we have the willingness to act accordingly?

Today, in the early days of 2026, there is some doubt about this question. Global, multiple crises and a severe shift in the spectrum of political actors on the European as well as all national levels take the focus away from sustainability and climate questions as primary fields of action. Though the new Commission "Von der Leyen II" retains the guidelines of their former policies, they must, in parallel, take into account the very dynamic movements in Eastern Europe and elsewhere in the world, leading to a large increase in military and defence investments. It shall not be questioned here that these decisions are made for the honourable task of securing the independence of the societal system of Europe, far beyond the borders of the present European Union. Nonetheless, this shift will have impacts on the abovementioned priorities, especially the investments in our railways. As the outcome of this development cannot be foreseen so far, it could lead to much less attention for the rail, but also to more budgets, e.g. for strategic reasons – this uncertainty remains for the moment.

From the perspective of a European business traveller, who uses the entire European rail network annually for around 120.000 kilometres, I would instead like to put emphasis on some "minor aspects" of the European railway system, that might contribute to a better effectiveness for the customers in mid-term. Just to mention the most important:

- Infrastructure in many regions is in a weak condition, especially on cross-border sections of the network. Whether it is the general reconstruction plan in Germany or maintenance work on short notice elsewhere, much too often the infrastructure is not available, which contradicts the longer-term planning needs of the passenger.
- Following the Law of Gravity, timetables are planned from the core needs of the domestic markets, usually starting at the nation's capital, spreading towards the outskirts of the country. Cross-border connections are working – if at all – only on an occasional basis. The very few exceptions of elaborate international railway hubs, such as Basel or Salzburg, are historically driven and not the result of an integrated international planning approach.

The "Via Vindobona" is one of the largest rail projects within the TEN-T networks in Central Europe. It will connect Berlin in Germany and Vienna in Austria via the Czech capital Prague, in hardly more than four hours, halving the present eight hours. Especially in the Czech Republic, the corridor Děčín – Ústí – Praha – Pardubice – Česká Třebová – Brno – Břeclav is most densely used by domestic and international passenger and cargo trains from a great variety of rail operators. Today, all the traffic basically runs on the two existing tracks, which requires a very sophisticated operational system. It depends on the skills of well-educated railwaymen to run trains, such as this domestic long-distance CD service from Prague to Děčín, safely and on time. In a couple of seconds, it will depart from Ústí nad Labem hl.n., heading through the picturesque Labe Valley towards its destination
Foto: Sebastian Beltz

- Ticketing and tariffs have been disintegrated throughout Europe on both sides, the national incumbents' and the new entrants'. In general, the idea of competition is to be appreciated, whereas at the same time, the chain of through ticketing from one place to another must not be broken for the passenger. Unfortunately, the disintegration led to a massive decrease in compatibility between operators, making especially cross-border travelling a vabanque game. Many European destinations are not for sale anymore at all. Surplus, seat reservation systems are very different with each rail operator, sometimes having high, often prohibitive prices, when wishing to buy a cross-border seat reservation.

To sum it up: cross-border passenger rail is not in the core focus of any player so far. There is no real "Single European Rail" entrepreneur in sight. All incumbents have strong domestic backgrounds, leading to "gravity blindness" against foreign markets. Europe still has no common philosophy, no definition of what European rail should look like. Good examples of cross-border rail projects are hard to find. They are often the result of strong individuals, not of a larger strategy or policy approach. "Border" seems to function as a vicious circle of low demand combined with high complexity, resulting in systemic neglect. Regarding the question of financing the missing link, the EU should probably change their mind to better "bridge the operational gap". The question "Is competition really always the best for cross-border rail?" should be negotiated undogmatically.

Finally, some very short recommendations: regarding infrastructure, the network density and resilience should be predominant against a pure high-speed focus. For timetabling, connectivity, reliability and frequency should be more in focus than single long-distance direct services. Tickets and tariffs should focus more on cross-acceptance than on a low price philosophy. Finally, and above all, competition and cooperation should not be regarded as opponents, but as different tools to both reach the best rail services possible.

As a "backbone for mobility", rail will only succeed with a strong, long-lasting support from the EU. Politics should urgently question their competition dogma and their non-consumptive-subsidies dogma. Both hinder broad growth, especially of cross-border rail services. To make the EU's 2021 claim become real, we need everybody on board! ●

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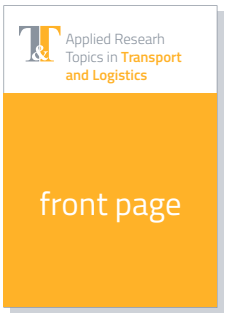

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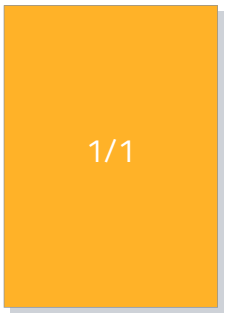

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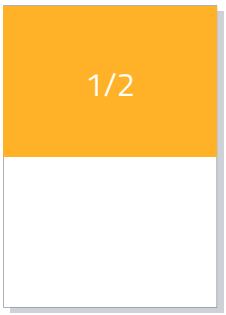

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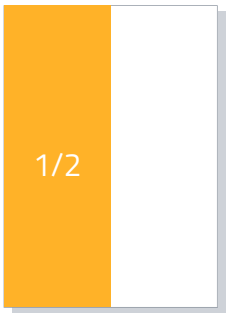

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06

Scientific and Professional Conference **ZIRP/TRANSCODE** on the Development of Transport, Logistics and Aeronautics Held

Prof. Mario Šafran, Ph.D.
President of the Organizing Committee TRANSCODE Conference

This year's edition once again confirmed its international recognition and significance, bringing together more than two hundred participants from Croatia and abroad. Through a total of 123 submitted papers, participants discussed current challenges and development directions in the fields of transport, logistics and aeronautics, with particular emphasis on scientific research and its practical application.

The formal opening of the conference featured welcome addresses by the Dean of the Faculty of Transport and Traffic Sciences, dr. sc. Marko Šoštarić, Associate Professor; the Vice-Rector of the

Foto: Darko Kužić

Foto: Darko Kužić

University of Zagreb, dr. sc. Tomislav Josip Mlinarić; the President of the European Conference of Transport Research Institutes (ECTRI), Ingrid Skogsmo; and the Chair of the Organising Committee, prof. dr. sc. Mario Šafran.

The conference programme included a series of presentations and panel discussions dedicated to innovative solutions in the organisation of transport processes, the enhancement of supply chains, and the development of sustainable and technologically advanced mobility systems.

Two keynote lectures held a prominent place in the programme. Ivan Cvitić, Assistant Professor from the Faculty of Transport and Traffic Sciences, University of Zagreb, delivered a lecture entitled "Emerging Cybersecurity Challenges and Trends in Transportation Systems", highlighting the growing cybersecurity challenges in modern transport systems. The second keynote lecture was delivered by Kenneth Øhrberg Krag, Chief Executive Officer of the Danish Cyclists' Federation, who, in his presentation "Pedalling the Future: Lessons from Denmark's Cycling Culture", presented the Danish model of developing cycling culture and sustainable mobility.

On the first day of the conference, a panel discussion entitled "The New Era of Transport & Logistics: Balancing Technology, Sustainability and Accessibility" was also held, during which experts discussed the alignment of technological progress, sustainability and accessibility in transport and logistics systems.

A significant contribution to the programme was made by ZIRP Youth, aimed at involving students and doctoral candidates in scientific and professional dialogue. Within this programme, young researchers presented their work with mentoring support, while international participants were also involved in a Blended Intensive Programme (BIP) approved by the University of Zagreb.

The second day of the conference featured the panel discussion "Women in Transport & Logistics", dedicated to the role of women in the transport and logistics sector. During the discussion, distinguished female managers spoke about professional challenges, career development opportunities, and the importance of ensuring equal opportunities in a field traditionally perceived as predominantly male.

One of the co-organisers of the conference was AMAC-FSC, with the Faculty's alumni once again actively contributing to the development of the profession and strengthening the connection between the academic and professional communities.

Foto: Darko Kužić

This year's ZIRP/TRANSCODE confirmed the importance of synergy between science, innovation and international cooperation in the development of smart and sustainable transport solutions, while Zagreb once again established itself as a relevant regional hub for hosting scientific and professional events in the fields of transport, logistics and aeronautics.

ICTCT 2026 – International Cooperation on Theories and Concepts in Traffic Safety

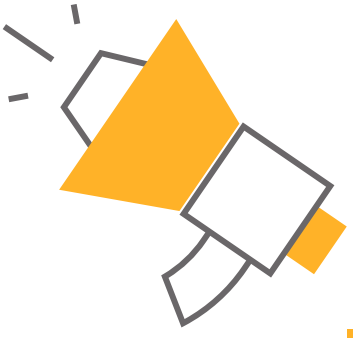
Organised by the Centre of Excellence for Road Traffic Safety at the Faculty of Transport and Traffic Sciences, University of Zagreb, the international conference **ICTCT 2026 – International Cooperation on Theories and Concepts in Traffic Safety** will be held in **Zagreb on 22–23 October 2026**.

The theme of the conference is **Road Traffic Safety in the Age of Artificial Intelligence: Innovations, Challenges and Opportunities.**

ICTCT is a long-standing international conference bringing together researchers, practitioners and policy-makers in the field of road traffic safety. The 2026 edition focuses on the growing role of artificial intelligence in road traffic safety, with particular emphasis on road user behaviour, the causes of road traffic collisions and the evaluation of safety measures.

The ICTCT Organising Committee invites the international road safety community to take part in the discussion and join us in Zagreb. Submissions are welcome in the form of: **extended abstracts or full research papers, work-in-progress papers, methodological or conceptual papers, and reviews of recent developments**. The deadline for abstract submission is 10 April 2026.

For further information, please visit:
https://ictct.com.hr/

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