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IK - Railway Research Institute

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**Editor's**

**Marianna Jacyna**

*Chairwoman of the Scientific Council IK*



The Scientific Council of Railway Research Institute is an opinion formulating and advisory body. It consists of 14 members having appropriate authority. Seven members are appointed by the Minister for Infrastructure and Development and other seven are chosen out of the workers of the Institute.

The term of office of the Council is four years, the current term finishes in 2016. To the tasks of the Scientific Council belong:

- evaluation of Railway Research Institute's activity in research, scientific and technical and implementation areas;

- preparation opinion of strategic and planning documents and reporting their realization. During sessions and discussion panels recommendations and guidelines for the management of the Institute in this area.

An important part of the Council activities is formulating opinions about implementation and economic reports presented to the Minister for Infrastructure and Development. Moreover, the Council formulates opinions about candidates for management, technical and scientific positions. The scope of Council's works includes also conducting election for the position of the director of the Institute and formulating opinion about person elected in the competition proceedings. We are delighted to inform that as the result of such proceedings, current director Mr D.Sc. Eng Andrzej Żurkowski was elected for the term 2015-2019.



### Perspectives of High Speed Rail in Poland

On 6th May 2015 took place a conference 'Perspectives of High Speed Rail in Poland'.

Catherine TRAUTMAN (DG Move) informed about possibilities of financing high speed rail and priorities of the transport policy of the European Commission.

Jean-Pierre LOUBINOX (UIC) presented the state of development of high speed rail and its dynamic development in the world. These issues will be the key issues of the World Congress on High Speed Rail in Tokyo, on 7<sup>th</sup>-10<sup>th</sup> June 2015.

In discussion the influence of importance of high speed rail on social and economic development was emphasized, particularly by Witold STĘPIEN, the Marshall of the Łódź Voivodeship.

A necessity of continuation of preparatory works related to the specific features of Poland including R&D was pointed out.



The conference "Perspectives of High Speed Rail in Poland"

### First European R&D Conference

Railway Research Institute (IK) delegate, Mr Zbigniew Szafranski, took part in the „European Rail Research & Innovation Conference – ERRIC”, organized by Oltis Group and ČD Cargo in Prague from 18 to 19 March 2015. The conference was organized for the first time and was connected with the fifth edition of the „ERFC – European Rail Freight Conference”, as a reference to a commonly created railway research undertaking *Shift<sup>2</sup>Rail*.

Key partners of organizers were: UNIFE, ERA, UIC, OSZD and actual (temporary) authorities of JU *Shift<sup>2</sup>Rail*. The aim of the conference was to undertake a debate about research activity in the fields foreseen for the "Horizon 2020" program. Taking into consideration the time when it was organized, the conference presented mainly the intentions and hopes related to JU *Shift<sup>2</sup>Rail*, as it is too early for the results of research programs. Whereas from the speeches and presentations comes out that the package of research projects will be centrally steered, leading towards pan-European and - above all - interoperational solutions. It is also expected that the research within *Shift<sup>2</sup>Rail* will enable to close so-called open points in TSI.

In the conference took part altogether 301 participants from 27 countries including those from outside Europe. In the part of the conference, in which the IK delegate took part- the common and ERRIC one – 52 speeches took place, which proves high interest in the subject matter. The hope shall be expressed that the second ERRIC will be to a large extent basing on the results of first works results within IPs (Innovation Programmes) of the *Shift<sup>2</sup>Rail* undertaking.



„European Rail Research & Innovation Conference – ERRIC”

### World Congress on Rail Training

Third World Congress on Rail Training was again organized at the initiative of the UIC Expertise Development Platform (in works of which delegates of IK have been actively taking part for several years). In this event took part c.a. 200 members (mostly representatives of railway educational centers from all over the world). Congress programme included plenary sessions, workshops and study visits. Presented papers included issues related to the following topics:

- Innovative and modern methods and ways of training for railway staff (conductors, drivers, dispatchers, cashiers etc.)
- Skills and predisposition of a 'good' coach;
- Railway safety;
- Simulator trainings for drivers and dispatchers;
- Customer service in passenger transport.

To the members there were also presented achievements and training possibilities of Portuguese railways (REFER). Methods and forms of training offered by presented centers may be used by preparing training offers of IK. Collected materials will be possible to use in the future in an article describing issues of educational trainings in selected European countries.



„World Congress on Rail Training”  
source: UIC

## Application of Structural Materials of Ultra-High Strength in Rail Vehicles

The paper presents a study of feasibility of weight reduction of selected examples of rail vehicle bodies. The project dealt with an application of structural materials such as an ultra-high strength family of steel instead of high strength steel, e.g. S355. First, a comparison between different kinds of materials was made. The results demonstrate reasons for choosing UHS steels. Examples of rail vehicles such as a container platform, a coal carriage wagon and selected wagon assemblies were taken into account in order to investigate the possibilities of mass reduction. As a result some structural members became lighter, while maintaining adequate strength and stiffness. The tare weight reduction makes the mass of the payload (with different values for different load cases) may be noticeably increased.

A few specific examples of rail vehicles were taken into account in order to investigate the possibilities of the weight reduction of their bodies. Following freight vehicles such as a container platform Sggn (see its underframe in Fig. 1), a coal carriage Eanos (Fig. 2) as well as selected connections of components used in such vehicles. Also a frame of a freight bogie was a good subject

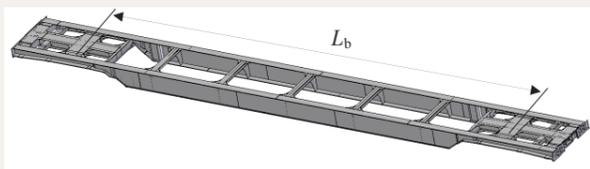


Fig. 1 Underframe of freight wagon Sggn with long base  $L_b$  for transportation of containers of length 20', 30', 40'

of a comparative analysis between the conventional and the new material.

Rationale for taking on this task is the fact that the weight reduction already has been applied, to a limited extent, in other areas, e.g. in the truck industry.

A major difficulty in the analyzes of the weight reduction of the rail vehicles is a very large number of load cases, which the bodies of the passenger and the freight wagons as well as the bogie frames must be subjected. Some of these loadings are not defined accurately and their values are often given with an excess. Such case occurs when the load is acting on the walls and on their reinforcements in the vehicles carrying the bulk material. The first task was to improve the material of the main members of the underframe of the container-wagon, having a large base length  $L_b$ , Fig. 1. The steel S355 was changed onto the UHS ( $R_e = 1400$  MPa). Besides the strength conditions, the rigidity of the underframe had to be controlled by use of the limitation of its vertical deflection  $|u_z|_{\max} \leq 0.003L_b$ .

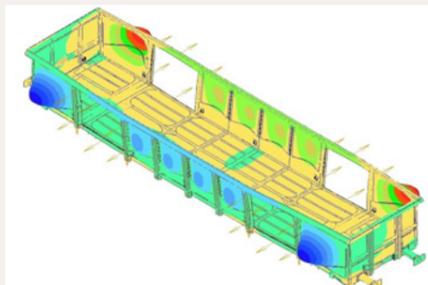


Fig. 2 Body of freight wagon Eanos, which may be modified for weight reduction; deformations due to bulk material

**Sławomir Walczak**  
Head of Rail Vehicle Division



As a result of the application of the ultra-high-strength steel (UHS) the side sills became lighter (the walls of the bars were thinner), while maintaining adequate strength for the vertical load. The tare weight was reduced by about 22%, so that the mass of the payload (in different values for different load cases) was noticeably increased. It was found that the material savings were possible while maintaining the stiffness condition, as shown in Tab. 2. Regarding the fatigue strength of the investigated structural members, there are some problems with connections between the longitudinal and transverse beams. They need to be changed in a certain qualitative way, because the improvement of the material only slightly widens the safety margin for these places (while the welds are thinner). Figure 2 presents a body of the most frequent case of the freight wagon, e.g. a high sided open wagon for the transportation of bulk goods (coal carriage). There are some typical load cases, but mostly important is a static and dynamic impact of the bulk material on the walls of the tank of the vehicle. In the last case, certain simplifications usually are made or more accurate methods of stress calculations are to be applied. As the effect of the project concerning the weight reduction of the high sided open wagon, were savings of the mass presented in the Table 3.

Table 2 Savings gained by changing material: S355J2G3 → UHS ( $R_e = 850$  MPa),  $t$  – thickness,  $|u_z|_{\lim} = 58.8$  mm

Most unfavourable load cases	Material	$\sigma_{\max}$ , MPa	$ u_z _{\max}$ , mm
VLC1: 4×20'	S355	77.3	29.75
	UHS	147.38	57.77
VLC2: 2×40'	S355	88.5	25.4
	UHS	142.31	41.7
VLC3: 20' and 2×30'	S355	87.82	33.3
	UHS	143.6	55.59

Table 2 Savings gained by changing material: S355J2G3 → UHS ( $R_e = 850$  MPa),  $t$  – thickness,  $|u_z|_{\lim} = 58.8$  mm

	Change	Mass savings	
Upper side walls, $t$	4 → 3 mm	570 kg	19%
Lower side walls, $t$	6 → 5 mm		
Floor, $t$	6 → 5 mm		
Underframe	UPN-380 → 350	128 kg	9%
	IPE-400 → 360	472 kg	
Body without bogies	Total savings	1170 kg	

Finally, a conclusion can be made, that the freight wagons would have decreased their weight through the modifications of their lower parts (underframes) as well as their upper parts (containers). One can say that particularly the containers of different types of the wagons for the transportation of the granular or aggregate goods are suitable for the task of gaining quite significant mass reduction by the improvements of the material.

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## ERTMS/ETCS Certification in Poland

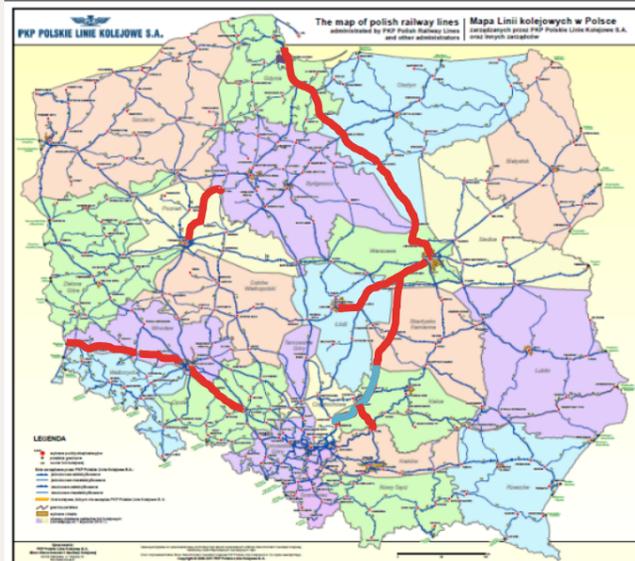
**Paweł Gradowski**

Engineering Project & ERTMS Research Coordinator  
Railway Traffic Control and Telecom Division



The European Union, by adjusting applicable law to realities, has obliged its member states (via infrastructure managers) to develop national plans of implementation of ERTMS. These plans were used to develop European strategy of implementation of ERTMS in territory of the European Union.

For several years in territory of Poland the infrastructure manager has gradually fulfilled arrangements of national plans of implementation of ERTMS by implementing



the system on subsequent lines. The scale of realization of subsequent investment projects is shown on the map above.

Apart from ordering and executing parties, in investment process as an independent third party there is also involved a notified body which supervises compliance of basic requirements and carries out the certification process.

The Railway Research Institute (IK) has a status of notified body No. NB 1467. Confidence of railway companies in many investment projects results in choosing IK as a body which conducts certification processes of e.g. control operation structural subsystem.

According to applicable law such process is conducted on three stages: design, execution and final tests based on a procedure chosen by contractor. In case of on-board system there is possibility to choose the type

examination together with product or its verification quality management system or quality management system examination with project examination phase sequence from design to commissioning. For track-side subsystem

apart from mentioned methods one can additionally use unit verification.

By completing next steps of control operation subsystem verification notified body confirms fulfilling by contractor requirements of compliance with elementary requirements of European and national law, specifications of ERTMS/ETCS



written in technical specification of interoperability, norms and recommendations referring to conducting of subsystem evaluation process.

Certification process after fulfilling all needed requirements is finalized by issuing to contractor an appropriate certificate of CE verification of subsystem. Finalized ERTMS system certification processes after providing appropriate documents requires admission by national safety authority – the Railway Transport Office (UTK).

Conducted by IK certifications, e.g. side-track system (railway route E 65 CMK) or on-board system (locomotive EP 09 series) are finished by issuing appropriate admission by UTK.

\* Own scheme of realized projects on railway lines map of PKP PLK S.A.

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## International Cooperation in Building Railway Corridor between Europe and Asia

On 30th November 2014 ended an European research project named with acronym NEAR2, concerning research of possibility of railway traffic between Europe and Asia. Apart from Railway Research Institute in this project took part 11 research institutes and universities from Europe and Asia.

The main goal of the project was to build railway research network in a corridor between Europe and Asia and to set efficient cooperation between railway research centers in area of promotion of research and development of railway transport not only for the duration of the project but also for the future. It was an interdisciplinary project involving both scientists and industry representatives and taking into account technical, economical and legal issues. An initiator and the leader of the project was EURNEX (European Rail Research Network of Excellence) association, currently consisting of 48 scientific institutes of railway transport and mobility within and outside Europe (Russia, China, India).

Within the project, partners formulated 10 so-called Concept papers in 10 areas of excellence: strategy and economics, operation and efficiency of the system, rolling stock, methods of product qualification, intelligent mobility, safety, environment and energy efficiency, infrastructure and signaling, human factors, education and training. In each of these areas current situation in Eurasian corridor was analysed with special attention paid to technological needs and gaps, that need to be filled in order that the corridor fulfills its role. A series of activities and recommendations was formulated. Creation of these documents showed that close cooperation in area of transport policy is needed, as well as understanding of market needs and issues of interoperability. They were a basis for formulating research priorities within the project and currently may be used to improve railway efficiency in mentioned corridor and search for an area to undertake



The Trans-Eurasian Railway Corridor

common research ventures. Cooperation of interdisciplinary teams of researchers representing different institutions and individual experts in particular railway disciplines broadened and deepened knowledge of needs ensuring creation of Eurasian railway corridor. It helped all the stakeholders to understand interdependences in such areas as: accessibility of infrastructure and its capacity, implementation of appropriate regulations in international politics, undertaking business decisions, creating strategies and taking actions.

**Magdalena Garlikowska**  
Research and Technical Specialist



Apart from reinforcement of current cooperation also development of new initiatives in wide area is expected, as well as reinforcement of weaker parts of the venture and support of different possibilities and their connections with industry needs. Serious research issues will be identified, which will be further developed and industry and researchers will be able to use recommendations formulated within the project.

The corridor between Europe and Asia has a serious potential to be a competitive intermodal alternative to air and waterways transport. However, it requires working on several issues: regulations, competition and open access to railway network. Main delays in railway transport appear because of crossing state borders, so the fluent railway traffic reducing journey time is needed. In this matter harmonization of forwarding documentation and achieving of interoperability will be helpful. Due to as quick as possible analysis of railway network connecting Europe and Asia several railway routes were examined by taking into account their advantages and disadvantages. This would allow to identify existing problems and areas of cooperation due to improve functioning of Eurasian corridor. Within the Project four railway routes were abstracted and analyzed:

- The Trans-Siberian route connecting Russian seaport in Vladivostok and Nakhodka with Moscow;
- The TRACECA Corridor (TRANsport Corridor Europe-Caucasus-Asia);
- The Trans-Asian Railway route (TAR), through Turkey and Iran;
- The railway corridors in Kazakhstan.

The analysis showed that basic problems are generated by several border crossings on one route, which cause serious trains delays, but also by different track gauge and power supply systems on the same route.

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Railway corridors connecting Western/Central Europe and Asia

## Fire Tests

**Jolanta Maria Radziszewska-Wolińska**  
Assistant Professor  
Head of Materials & Structure Laboratory



In the mid-twentieth century, the railway has become a mass transport. Its growing popularity resulted in accelerating the development of vehicle design. The aim was to reduce their weight, increase speed, and to increase the comfort of the passengers. Appearance of the vehicles and its aesthetic value have become also an important issue. Thus began the introduction of new, modern

materials produced on the basis of synthetic or modified natural polymers. The development of the chemical industry made it possible in wider and wider range. However, it was found that plastics in addition to the many advantages also have disadvantages, including high susceptibility to ignition.

The increasing number of fires which were more and more dangerous for passengers of rolling stock initiated at the end of the 70s of the twentieth century research aiming to develop laboratory methods for determining the



Test stand according to PN EN ISO 4589-2 Determination of burning behaviour by oxygen index. Part 2: Ambient temperature test



Test stand according to ISO 5660-1 Fire test – Reaction to fire Part1 Rate of heat release

flammability and smoke properties of materials and the classification requirements for rolling stock. This is important, because the scale of a fire in rail vehicles strongly depends on the type and quantities of specific structural and furnishing materials applied in such vehicles.

IK was one of the first in Europe, and has initiated actions in fire safety rail vehicles in Poland. We have developed of Polish standardization in this area and

also we have implemented UIC requirements.

Subsequently introduced new standards resulted in decrease in the number of materials that meet the requirements.

However, new requirements became an impulse to modify manufacturing processes, including the use of flame retardants and contribution to the gradual improvement of the properties of the tested products.

Also these requirements contributed to decrease of the number of registered cases of fires in passenger rolling stock.

Institute also-

took part in development of European Standardization.

Now our Materials & Structure Laboratory, which carries out fire tests is equipped in most of test stand, that required by EN 45545-2:2013.



Test stand according to ISO 5660-1 Fire test – Reaction to fire Part1 Rate of heat release

Implementation of above EN for use in all areas (design, laboratory tests, purchasing procedures, production,



Test stand according to ISO/TR 9705-2 – Reaction to fire tests – Full scale tests or surface products

maintenance, etc.) will be a challenge, but in the future should facilitate the functioning of the European rail market and reduce the fire risk in rail vehicles.

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## Shift<sup>2</sup>Rail – New Tool Supporting R&D In Railway

Shift<sup>2</sup>Rail Joint Undertaking (S<sup>2</sup>R) set up within the framework of Horizon 2020 Programme is aimed to stimulate and better coordinate Union research and innovation investments in the rail sector. S<sup>2</sup>R is assumed to make a significant contribution in realization of following postulates: considerable expansion or upgrading of the capacity of the rail network, so as to enable rail to compete effectively and take a significantly greater proportion of passengers and freight transport; improvement in the quality of rail services by responding to the needs of rail passengers and freight forwarders; removal of technical obstacles holding back the sector in terms of interoperability and reduction of negative externalities linked to railway transport.



S<sup>2</sup>R was established for the period to 31 December 2024 under the EU Council Regulation No 642/2014 of 16 June 2014 which defines detailed rules of its organization, functioning and financing. S<sup>2</sup>R is supposed to function as a Public-Private Partnership. The founder on the public side is the UE, represented by the European Commission (EC) and on the private side – Founding Members other than the UE: Alstom Transport, Ansaldo STS, Bombardier Transportation, Construcciones Y Auxiliar De Ferrocarriles, Network Rail, Siemens Aktiengesellschaft, Thales i Trafikverket.

S<sup>2</sup>R will carry out tasks within five packages called 'Innovation Programmes' (IP):

- IP1 Cost-efficient and Reliable Trains, including High Capacity Trains and High Speed Trains;
- IP2 Advanced Traffic Control & Management Systems;
- IP3 Cost-efficient and Reliable High Capacity Infrastructure;
- IP4 IT Solutions for Attractive Railway Services;
- IP5 Technologies for Sustainable & Attractive European Freight.

Apart the EC and Founding Members to S<sup>2</sup>R may contribute another entities or consortia if they will be selected as Associated Member through an open and competitive call, or other entities whose project proposals will be accepted in response to the open calls, as well as S<sup>2</sup>R direct members' subcontractors.

**Eliza Wawrzyn**  
Scientific assistant



The call for expression of interest to become Associated Member of S<sup>2</sup>R was launched by the EC in October 2014 and is a two-stages procedure. In the competition takes part EUROOC (European Rail Operating Community Consortium), which successfully completed the first stage of evaluation.

EUROOC is comprised of 14 entities: Infrastructure Managers and Railway Undertakings representing 11 countries (European Member States including new Accession States) and covers a wide geographical range (Fig. 1).

Railway Research Institute (IK) actively cooperates with Pol-



ish State Railways (PKP), Polish Railway Lines (PLK) and PKP Cargo in EUROOC works by defining key research areas within mentioned IP's, that contribute to improvement of rail transport in Poland by developing innovative solutions that are more economically efficient and in line with needs of customers. Proposals of IK con-

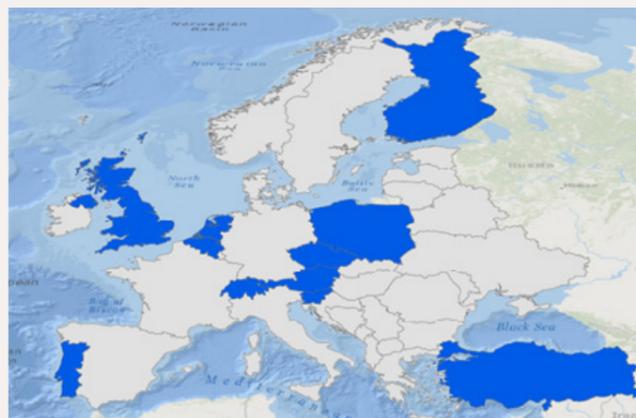


Fig. 1 Members of EUROOC consortium

cern projects in following areas: infrastructure of stations and stopping points, track construction, switches and crossings, rolling stock braking system, energy efficiency and fail safe communication and positioning systems.

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### Railway Reports magazine

Railway Research Institute is the publisher of 'Railway Reports' scientific quarterly. The magazine has been issued since 58 years and it is the oldest journal presenting articles which describe problems of railway in comprehensive manner.

The quarterly presents current technical, organizational and economic issues of railway sector. The problem approach to presented topics distinguishes 'Railway Reports' on the publishing market. All issued articles are reviewed and must not be published in other magazines before. We prefer texts written in English.

Our journal promotes scientific and technical achievements in the field of railway construction, technical and technological development and organization of rail transport, aiming at its development both in Poland and abroad.

That arises from the fact, that the increasing number of authors and reviewers represent scientific centres outside of Poland.

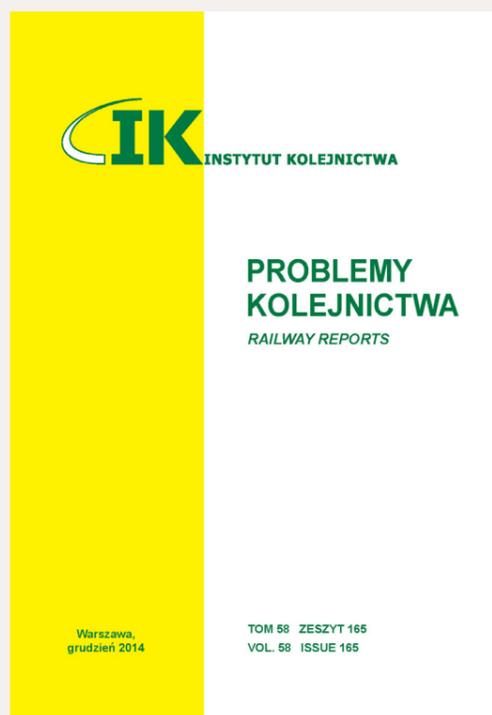
'Railway Reports' magazine is scored on the Minister's of Science and Higher Education list.

We invite authors from Poland and abroad to publish in our magazine.

Joanna Cybulska

Director's Representative for Scientific Publications in IK

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### Advanced Rail Technologies 18-19 November 2015



In November 2015, Railway Research Institute and the Faculty of Transport of Warsaw University of Technology organize 4<sup>th</sup> International Conference on Advanced Rail Technologies. The conference is a platform of exchange of ideas related to various aspects of railway transport. It aims to present the achievements of scientific and research centres both national and international, dealing with implementation and operation of modern technologies in area of railway transport. The conference programme covers theoretical and practical issues related to the following research areas: rail transport, operation, rail transport infrastructure, traffic control and IT for railway, traction and rolling stock, material engineering and recycling, transport organization and technology, certification in the rail transport. The conference programme includes also plenary sessions prepared by outstanding scientists from national and foreign academic centres and research institutes.

We kindly invite to participate in the conference and follow Railway Research Institute website: [www.ikolej.pl](http://www.ikolej.pl)

On behalf of Organizational Committee:  
Chairman prof. M. Siergiejczyk

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