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Editor's

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Development through investments

The Railway Research Institute is systematically strengthening its market position. An essential strategic goal is to build the Institute's strength and its development through the implementation of ambitious investment plans. Good financial results have provided a solid basis for financing investments both from the Institute's own resources as well as from obtaining funds for



Photo: IK

investments from various operational programmes dedicated to implemented projects. Record investments in 2018 amounting to PLN 12.6 million were incurred not only for the purchase of modern research equipment but also for comprehensive thermal modernization of buildings.

As part of the project co-financed by the National Fund for Environmental Protection and Water Management, over 60% of the total area of all the Institute's buildings has been thermally upgraded. Currently, as part of the Regional Operation Programme project, the Institute is purchasing modern research and laboratory equipment with a total value of PLN 7 million. The use of this apparatus will expand the Institute's research offer of cooperation with companies implementing innovative solutions and advanced technologies. The Institute's investment plans also include the construction of two new measurement stands (stations) worth PLN 4.5 million, which will be used to perform tests in the field of photometric measurements and measurements of emissions and immunity of railway equipment and systems.

In recent years, electronic management support systems have been implemented at the Institute. A significant part of the Institute's profit is allocated to the Internal Research Fund, from which approximately 20 internal projects are financed each year. Consistently implemented investment plans not only increase the value of assets, balance sheet total but also improve the image of the Institute and create opportunities to acquire new competences in the field of research and development.

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International Railway Fair TRAKO 2019

International Railway Fair TRAKO 2019 was held in Gdańsk on 24–27 September 2019. During this year's 13th edition of this event, the Railway Research Institute, once again, took part in them as an exhibitor, presenting its offer regarding in particular: initiating and conducting scientific research as well as research and development projects, performing analyses and opinions, certification, National Technical Assessments, independent safety assessment, as well as adapting to the needs of practice and implementation of the results of scientific research and development projects. The joint stand of the Railway Research Institute, the Ministry of Infrastructure, the Centre for EU Transport Projects and the Office of Rail Transport was awarded in the competition for the most attractive exposition of the TRAKO Fair, in the category of stands over 30 m².

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Photo: IK

A visit paid by representatives of Romanian Railway Authority to the Test Track Centre in Żmigród near Wrocław

On 18 September 2019, the Railway Research Institute hosted representatives of Romanian Railway Authority – RRA (Autoritatea Feroviară Română) Marian Mihail Călin – General Manager, Laurentiu Nicusor Zaharia – Head of Laboratories and Alexandriu Ion – Head of International Cooperation Department. Romanian Railway Authority is the railway and subway specialized technical body of the Ministry of Transport. The visit was paid within the framework of a cooperation agreement signed in 2016. During the visit, the guests became acquainted with the functioning of the Test Track Centre. They were particularly interested in the technical parameters of the track and the scope of research carried out on it. The talks focused on the possibility of strengthening the cooperation and updating the contract, including joint activities to promote the need for experimental confirmation of the approvals and safety of introduced technical solutions.



Photo: IK

International Scientific and Practical Conference "Energy-optimal technologies, logistic and safety on transport"

The 2-nd International Scientific and Practical Conference "Energy-optimal technologies, logistic and safety on transport" (EOT-2019) was held in Lviv on 19–20 September 2019.

The organizers of the conference included:

- Dnipro National University of Railway Transport,
- **Railway Research Institute (Warsaw)**,
- Non-Governmental Organization "Linia102.Ua",
- Faculty of Transport of Warsaw University of Technology,
- Western Center of the Ukrainian Branch of the "International Center for Scientific Culture - World Laboratory" (Lviv).

The conference took place under the patronage of the Reform Support Team of the Ministry of Infrastructure of Ukraine, Lviv Regional State Administration and JSC Ukrainian Railway. The results of the research in the following scientific directions were presented at the conference:

- energy-optimized technologies, energy efficiency and energy management on transport,
- ecology of rolling stock and objects of transport infrastructure,
- interoperability, safety and certification on transport,

- modern technologies of organization of international transportations and logistics,
- transport design,
- interaction of railways and industrial enterprises.

Over 140 participants attended the conference

(including nine employees of the Railway Research Institute).

The conference participants represented 36

institutions (mainly scientific) from the following countries: Ukraine, Republic of Poland, Belarus, Spain, Italy, Russian Federation, Slovak Republic, USA, Federal Republic of Germany, Czech Republic. The vice-chairman of the scientific committee is Dr. Eng. Andrzej Żurkowski, while a member of the organizing committee is Dr. Eng. Andrzej Białoń. The official languages of the conference were: Ukrainian, Polish and English.



Photo: IK

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Verification Issues of Control-Command and Signalling On-board Subsystem

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Providing railway interoperability is strictly related to the introduction of unified rules for the assessment and verification of the ETCS and GSM-R subsystems that are part of the European Rail Traffic Management System (ERTMS). Specifications for Interoperability (TSIs) for particular subsystems, contain the requirements that must be met in order to achieve

full technical harmonization of the railway. Dedicated to the relevant subsystems, the TSIs have the same structure, where the essential requirements, basic parameters, interfaces with other subsystems, the scope of necessary checks and inspections in order to obtain EC verification certificates, etc. are described. The confirmation of meeting the TSI requirements by the subsystem allows obtaining EC certificate issued by the notified body.

The process of EC Verification of Control-Command and Signalling On-board Subsystem is complex and requires numerous and time-consuming checks. In many aspects related to this task there are difficulties in interpreting the provisions of European requirements. Therefore, relevant guides and recommendations related to EC evaluation processes are published. Moreover in this regard qualifications of employees of notified bodies are also very important.

Regardless of the module selected the verification must show that the control on-board system subsystem after integration with the vehicle meets the basic parameters. These parameters are presented on Figure 1.

Assembly	Part	Basic Parameters
On-board	train protection	4.2.1, 4.2.2, 4.2.5, 4.2.6, 4.2.8, 4.2.9, 4.2.12, 4.2.14, 4.2.16
	radio communication	4.2.4, 4.2.5, 4.2.6, 4.2.13, 4.2.14, 4.2.16

Fig. 1. On-board basic parameters scope according to TSI

Figure 2 shows the structure of Control-Command and Signalling On-board Subsystem that is a subject of EC verification.

At the same time, it is acknowledged that no additional verification of functions and operating parameters is

required for the interoperability constituents included in the subsystem that have been covered by the EC declaration of conformity. When analyzing the requirements for assessment of the on-board subsystem special attention should be paid to the need of conducting tests in operating conditions that will confirm proper integration with the Control-Command Track-side subsystem and other subsystems.

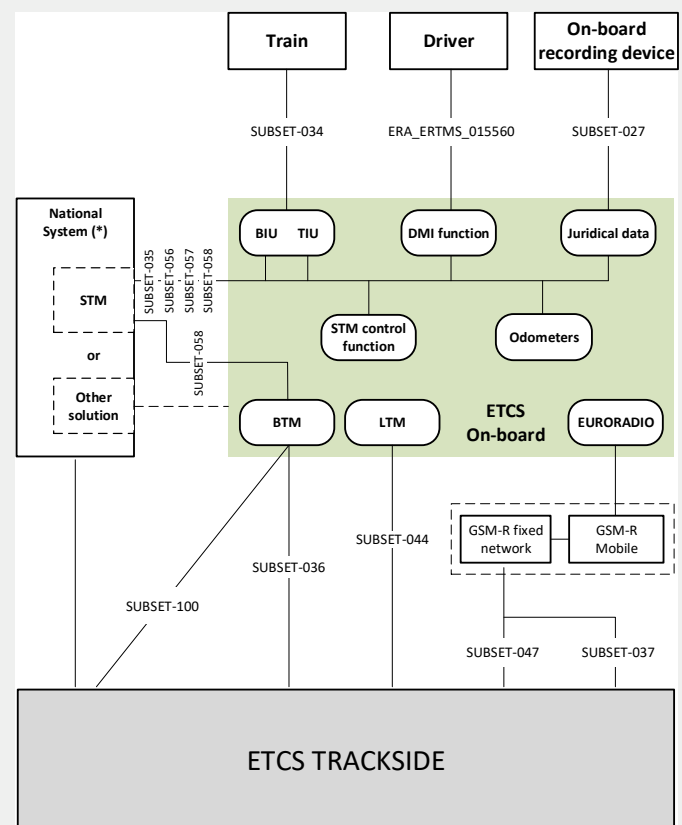


Fig. 2. Structure of the ERTMS/ETCS onboard subsystem with interfaces

The Railway Research Institute has the necessary knowledge and experience in conducting EC verification processes of interoperability constituents and Control-Command and Signalling subsystem.

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EU Funding for Research and Innovation in 2021–2027

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The efforts to establish the next EU Research and Innovation Investment Programme Horizon Europe are underway. The European Commission proposes a budget of € 100 billion for the coming financial perspective period of 2021–2027. Horizon Europe is the most ambitious-ever programme pertaining to research and innovation. It will follow

the achievements and success of the previous financial perspective - Horizon 2020. It is due to bring new and broader knowledge as well as new and more numerous technologies. Horizon Europe will be implemented in 3 pillars (Fig. 1):

- Pillar 1 Excellent Science will ensure a stable continuity of support granted within Horizon 2020 for reinforcing and extending the excellence of the Union's science base applying a bottom-up approach to strengthen the EU leading position in the area of science and development of high quality knowledge and capabilities. Within this pillar there will be supported pioneer research programmes defined and carried out by researchers through the European Research Council, funded scholarships and exchanges for researchers through Marie Skłodowska-Curie actions as well as conducted investments in the world-class research infrastructure.
- Pillar 2 Global Challenges and European Industrial Competitiveness will cover actions to boost development in the area of social challenges and industrial technologies. The activities will be organized in five clusters (Health, Inclusive and Secure Society, Digital and Industry, Climate, Energy and Mobility, Food and Natural Resources) compliant with the Union's and global policy priorities (Sustainable Development Goals) and the key driving force i.e. cooperation and competitiveness. This pillar will foster direct research relating to social challenges, strengthened technological and industrial capabilities, established all-Union's missions of ambitious goals to solve some of our major problems. This pillar also involves Joint Research Centre's activities which supports persons who shape the EU and national policies by equipping them with independent research evidence and technical support.
- Pillar 3 Innovative Europe will focus on extending the innovation scale of breakthrough research through establishing the European Innovation Council. This Council will function as a complex service for high-potential innovators. This will help to shape the European innovation market, including fostering the European Institute

of Innovation and Technology (EIT) in order to support the integration of enterprises, research, higher education and competitiveness.

Horizon Europe will double the support granted for the EU Member States for sharing excellence in order to intensify efforts aiming at the best use of national research and innovation potential.

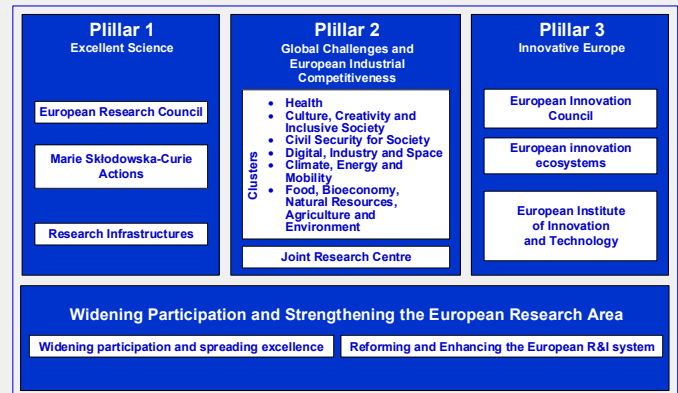


Fig. 1. Horizon Europe pillars

The European Parliament and the Council reached agreement on the Horizon Europe programme on 19.03.2019. The budget, synergies and association of third countries are still pending agreement, which will depend on the outcome of the overall negotiations on the multiannual financial framework. It is known that the European Commission has proposed a budget of € 100 billion for the Horizon Europe programme for 2021–2027 (Fig. 2). This budget includes € 97.6 billion for Horizon Europe, of which € 3.5 billion will be allocated to the InvestEU Fund and € 2.4 billion for the Euratom research and training programme.

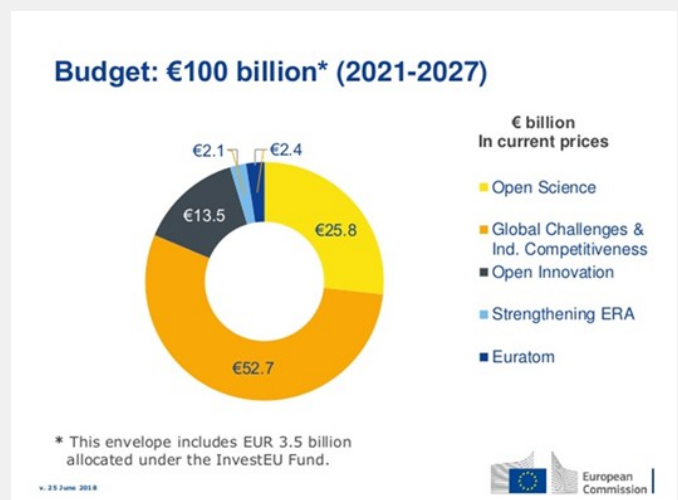


Fig. 2. Horizon Europe proposed budget

The InvestEU Fund's thematic segment dedicated to innovation will allow the use of loans, guarantees, equity and other market instruments to launch public and private investments in research and innovation. The Euratom programme, which funds research and training in nuclear safety and security, nuclear physical safety and radiological protection, will be more focused on non-power applications such as healthcare and medical equipment, and will open the mobility opportunities for nuclear researchers through inclusion in Marie Skłodowska-Curie actions.

Horizon Europe will base on the achievements and success of the current Horizon 2020 programme. It will continue stimulating Europe's science excellence through the European Research Council and through scholarships and exchange within Marie Skłodowska-Curie actions, take advantage of scientific advice, technical assistance and special research of the Joint Research Centre (JRC), the European Commission's scientific service.

Within the Horizon Europe framework the following key novelties will be introduced:

- European Innovation Council (EIC) to offer support so that the EU would be the leader of innovation in creating markets: in the Commission's motion there was provided the establishment of one-stop shop services enabling transfer of high-potential breakthrough technologies from laboratories to market applications and offering assistance to the most innovative and well-grounded enterprises to develop their ideas. The new EIC will indicate and fund fast developing high-risk innovations which have a high potential to create new markets. It will directly support innovators through two main funding instruments: one for preliminary stages of work and the other for the development and market implementation. This activity will complement the work of the European Institute of Innovation and Technology (EIT).
- New EU missions in the area of research and innovation challenges and industrial competitiveness: within the Horizon Europe programme the Commission will launch new missions which will have bold and ambitious goals and high European added value so as to solve problems affecting every day life. The example of their thematic scope may cover such different problems as fighting cancer, clean transport or cleaning oceans of plastic waste. These missions will be created together with citizens, interested parties, the European Parliament and the Member States.
- Maximizing the innovation potential in the whole of the EU: support for the less developed EU Member States in their efforts to fully use their national research and innovation potential will double. Moreover, new synergies with the Cohesion Fund and structural funds will facilitate the coordination and leverage funding as well as help regions to implement innovations.

- Greater openness: The "excellent science" principle will become the default mode of Horizon Europe operation, with the requirement to ensure open access to publications and data. This will contribute to the absorption of the results of EU-funded research by the market, as well as increase the potential for innovation.

- A new generation of European partnerships and enhanced cooperation with other EU programmes: Horizon Europe will sort out the number of partnerships that the EU co-programmes or co-finances with actors such as industry, civil society and funding foundations to increase their effectiveness and impact on achieving European goals in policy area. The Horizon Europe programme will promote effective operational links with other future EU programmes, such as the cohesion policy, the European Defence Fund, the Digital Europe programme and the Connecting Europe Facility, as well as the international ITER project in the field of fusion energy.

The Joint Research Centre (JRC), i.e. the Commission's services dealing with knowledge and science, will continue its contribution through scientific advice and special research.

The level of research and innovation investment in Europe is still well below the policy target of 3% GDP, and its growth is lower than our main competitors', such as the USA, Japan, China and South Korea. Due to the EU funding, teams of scientists from different countries in different scientific disciplines can collaborate and make discoveries in research and innovation.

Horizon Europe is a new framework programme created to ensure maximum impact against the changing nature of research and innovation, with a structure designed to achieve greater cohesion and better results. It is proposed to use a structure composed of three interconnected pillars and supplemented with support activities to strengthen the European Research Area. Horizon Europe will largely be a continuation of the current Horizon 2020 programme, retaining such elements such as the three pillars, excellence as a focal aspect of research and maintaining best practices and funding policies within Horizon 2020. However, it will be improved to maximize its impact, societal significance and potential for breakthrough innovation.

On 11 September 2019, the European Commission launched public consultations on future European partnerships, which will have a significant impact on the subjects of international competitions of the Horizon Europe programme in the future perspective of 2021–2027.

Source: European Commission

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Competition as an Element of the Rail Market Development

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The single and demonopolized European rail market has been the focus of the European Union's efforts for many years. The liberalization process of this market has been going on for around 30 years. However, despite the implementation of the so-called three railway packages (2001, 2004 and 2007), many countries still cannot boast of the full liberalization of their markets.

The liberalization of the rail market in the European Union resulted in the intensification of the railway sector development with the use of foreign capital, but without a greater engagement of state-owned financial instruments. As practice shows, subsidies are not the best way to finance transport. It happened that it was an official who decided to grant funds without knowing or misinterpreting transport needs of residents in a given area. This in turn contributed to the improper functioning of the transport system, and further - to lower profits from transports and the increase in the scale of e.g. congestion, as there were more and more wheeled vehicles due to the reluctant use of rail transport.

Private and also successful in this sector carriers operating in Europe are an example that railway can be a strong competition for individual transport. However, it is not possible for all services to be provided only on market terms. It is a matter of defining public services correctly in both national and European law. Above all, they should be entrusted only in a socially justified scope and purpose. If state intervention is unnecessary in a given area, such transport should not be classified as public services. The correct development of transport plans is crucial here.

Little interest among private entrepreneurs results, inter alia, from the large costs of accessing the rail market, much larger than in the case of road transport. But there are also more optimistic aspects of this situation, e.g. the fact that rail vehicles have a longer service life. In Austria and Switzerland, it is a popular practice to modernize formerly operated wagons and then make them available to private operators, at least for the purpose of starting rail transport operations. Also in Italy, a private passenger operator (NTV - Nuovo Trasporto Viaggiatori) succeeded in launching high-speed connections in 2012, which had been recognized so far as the state domain due to the high costs of rolling stock and its maintenance. Currently, it runs transport services between important Italian cities and has an offer of bus services by organizing access journeys to its trains, thus increasing the availability of services offered.

With this type of venture, there are always concerns, mainly financial ones, but also regarding the reduction of demand for transport by rail. Private companies, therefore, focus on stability and certainty, which helps to gain the trust of customers and, finally, the expected profit from operations. In the case of the abovementioned Italian operator, the fears turned out to be unjustified. When the interest in transport services increases,

the total number of railway connections increases. Statistics show that railways in this country have become competitive in relation to road and air transport. The fight to gain customers, expanding the offer and reaching new recipients is stimulating the dynamic development of the railway, and thus is an incentive for the development of the operator's transport network and its better financial condition.

When analyzing the Central European market, private Czech operators can also talk about success. In 2009, the Czech authorities decided to liberalize access to railway infrastructure. They also introduced equal conditions for passenger transport operators on the Prague - Ostrava section to create an opportunity to supplement the existing transport offer. The state reduced the subsidy for long-distance transport services in this section, which allowed saving funds and assigning them to raising the standard of infrastructure throughout the country. This made the railway more attractive than individual road transport.



Along with the improvement of the infrastructure technical parameters, new operators appeared - Leo Express and RegioJet. They have managed to achieve sufficiently positive results and are now successfully developing their network of connections also by using road transport to complement their transport services.

A private operator, who does not receive subsidies for the provision of public services, has one source of income - ticket sale. Expenses incurred primarily relate to:

- access to railway infrastructure,
- traction energy / fuel costs,
- employee remuneration,
- rolling stock maintenance,
- other operating costs that do not exceed 5% of the total expenditure structure.

Fees for using the railway infrastructure in Poland are much higher than in the Czech Republic and Slovakia (almost 100%), and close to the fees established in Germany, where the amount depends on the maximum speed of the train - the lower the speed, the lower the fee). The amount of these rates is a serious barrier to the liberalization of the rail market and certainly deters potential private entrepreneurs from the commencement of passenger transport operations.

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Stand for testing immunity to conducted disturbances, induced by radio frequency fields

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Due to the nature of the railway environment, i.e. large impacts of other systems installed on the track and in its close vicinity, as well as rolling stock, all electrical and electronic devices must meet the normative requirements regarding electromagnetic compatibility.

Standards PN-EN 50121-3-2 and PN-EN 50121-4 clearly define the necessity to carry out such tests, including tests of immunity to conducted disturbances, induced by radio frequency fields. The source of these disturbances is the electromagnetic field emitted by RF transmitters which can affect the entire length of cables connected to the installed device. The cables incoming and outgoing the EUT (e.g. power supply, communication lines) behave like passive receiving aerials circuits and conduction pathways of both intended and unintended signals.

This year, the Signalling and Telecommunications Laboratory has expanded its competences purchasing a modern stand from a leading manufacturer of EMC equipment for testing immunity to conducted disturbances, induced by radio frequency fields for electrical, telecommunications and electronic products and equipment according to standards PN-EN 61000-4-6: 2014 - Fig. 1. Thanks to it, the Railway Research Institute has the potential to check the performance of a device or system working in a railway environment to maintain its properties when exposing specific circuits, ports or interfaces.



Photo: IK

Fig. 1. Stand for testing immunity to conducted disturbances, induced by radio frequency fields

The most important parameters of the system include:

- Operating frequency range: 150 kHz - 230 MHz;
- Voltage level, as unmodulated voltage for open circuit - 1 ± 10 VRMS;
- Maximum current:
 - $I_{max}=16$ A DC;
 - $I_{max}=16$ A AC (single phase device);
 - $I_{max}=32$ A AC (three-phase device).

The test stand consists of:

- RF generator;
- Coupling/decoupling systems:
 - CDN-M 1/2/3/5 – Power supply;
 - CDN-S 8, USB-P, USB-C, USB 3.0-P, USB 3.0-C; - Shielded;
 - CDN-T 2/4/8- Telecommunications;
 - CDN-AF 2/3/4- Asymmetrical.
- EM clamp - a device for injecting disturbances with complex and capacitive and inductive coupling.

One of the overarching objectives of the Signalling and Telecommunications Laboratory is to expand the scientific facilities while maintaining the highest quality performed test. The purchase and construction of state-of-the-art measuring systems is an indispensable element of the competence expansion process. The acquisition of a new stand for testing immunity to conducted disturbances, induced by radio frequency fields, allowed eliminating external subcontractors, thus improving the entire research process. Due to the extension of accreditation PCA No. AB 310 for the PN-EN 61000-4-6: 2014 standard, the test contractor has the certainty of correct and reliable measurement carried out by competent technical personnel.

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International Scientific and Practical Conference „Energy-optimal technologies, logistic and safety on transport” (cont.)

During the conference sessions, 89 reports were presented.

The following presentations were given by the Railway Research Institute's employees:

- Concept of the railway safety, security and cybersecurity functional integrity levels (Marek Pawlik),
- Actual utilisation of maximum line speed - Polish and Ukrainian experience (Andrzej Massel),
- Research on measurement of electromagnetic fields generated by electric and combustion powered rolling stock (Dominik Adamski, Krzysztof Ortel, Juliusz Furman),
- Analysis of emission tests of electromagnetic disturbances in diesel-electric locomotives (Andrzej Białoń, Kamil Białek, Patryk Wetoszka),
- Contact arc time – important parameter of DC high-speed circuit-breakers (Artur Rojek, Marek Skrzyniarz),
- Mathematical model of pantograph cooperation with two degrees of freedom with a catenary system (Marek Kaniewski, Michał Cichoński)
- Selected aspects of proper integration between ERTMS/ETCS on-board and trackside devices (Dominik Adamski, Andrzej Białoń, Łukasz Zawadka).

The aforementioned presentations were placed in the Web of Science - WoS (MATEC). The conference materials included the article by Magdalena Kycko entitled "Risk in the control-command and signaling subsystem certification processes" as well as summaries of the presentations published in the WoS.



The conference allowed for an interesting exchange of scientific views and results of research conducted by the conference participants.

The third edition of the conference will take place in 2020 and will also be attended by the Railway Research Institute's employees.



During TRAKO 2019, on 24 September, a conference **"We are changing the Polish railway"** was organized by the Ministry of Infrastructure, the Railway Research Institute, PKP S.A., PKP Polskie Linie Kolejowe S.A. and the Land Transport Chamber of Commerce (IGTL). The conference was opened by Andrzej Adamczyk, the Minister of Infrastructure. It consisted of two thematic panels: Investments, innovations, digitization – driving forces of the Polish economy and Strategy for efficiency. Among the issues raised there were: rail investments as a driving force for the Polish economy, innovation - digitization of railways, infrastructural conditions for the development of transport, Central Transportation Hub, market model (consolidation vs competing entities), transport policy and modal shift, ownership matters and relations with local governments, HSR to Budapest, 4th Railway Package, as well as the KOLEJ PLUS package.

The panelists included Andrzej Bittel (Secretary of State in the Ministry of Infrastructure, Government Proxy for Counteracting Transport Exclusion), Tomasz Buczyński (Director of Railway Department in the Ministry of Infrastructure), Krzysztof Mamiński (CEO PKP S.A.), Ireneusz Merchel (CEO PKP Polskie Linie Kolejowe S.A.), Andrzej Massel (Deputy Director of Railway Research Institute); Marek Pawlik (Deputy Director of Railway Research Institute); Marita Szustak (President of IGTL); Andrzej Wach (Board Advisor of PORR S.A.), Jakub Majewski (CEO of ProKolej) and Adrian Furgalski (Board Member of Transport Consultants Group TOR).

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