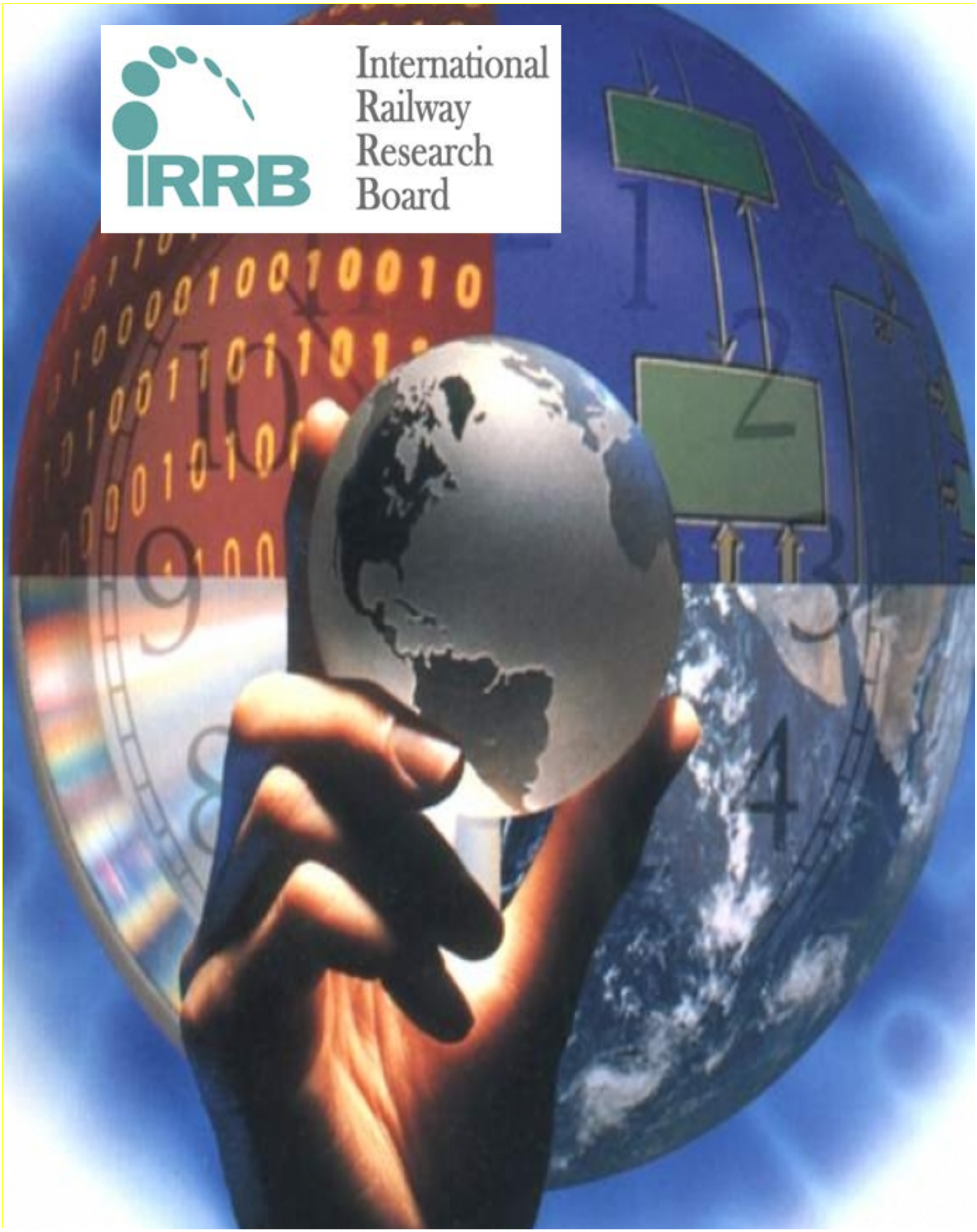
IRRB
International
Railway
Research
Board

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Introduction

Railways are a mode of transport directed towards the future of the world community. Railways are striving to be even more attractive, accessible, safe, clean and competitive serving all customers, as well as being more efficient themselves as a system and interrelated with other modes of the world transport system.

Demand for transport services is growing steadily and, thanks to its relatively "green" nature, rail has the potential to be the preferred means for mobility around the globe. At the same time as demand grows and volumes increase, the shortage in railway capacity will be sorely felt.

Railway efficiency is therefore a crucial ingredient in driving the economies of industrially developed countries along the path of modernization, innovative development and sustainable growth.

Efficiency is not only important for socio-economic development, but also a state's ability to effectively perform essential functions such as meeting the needs of citizens for mobility and transit of goods and improving overall transport security.

The leading position of railways will be determined by their ability to offer year-round regular operation, transporting a majority share of bulk commodities and ensuring workforce mobility. The strategic importance of railways will also be determined by the remoteness of certain regions consuming resources from sea ports or their inaccessibility via sea or road route.

The incapacity of railways overcome external challenges or their lack of flexibility may lead to a situation where possible economic gain turns into a problem.

Analysis of problems related to railway transport brings out the following key points:

- necessity to reduce territorial discrepancy in railway infrastructure development, improve links between regions and line capacity;
- necessity to lift restrictions on increasing passenger and freight traffic volumes;
- Necessity to improve safety and railway customer satisfaction.

This, all points to a requirement to continue improving rail transport efficiency, primarily through development and implementation of innovative solutions. Fostering research and innovation depends on deeper cooperation among the scientific community and railway entities.

Planning of long-term railway research and development is determined by:

- closely related objectives nurture research on possible development of the transport system and market requirements in terms of services to be provided, their quality and cost;
- medium to long term visibility (about 20 years) for the work cycle starting from when research begins;
- calculation of time required to go from design and construction to putting into operation, achievement of projected capacity increase all the way to first yields from railway infrastructure investments;
- considerable losses caused by unjustified decisions on modernizing of railways transport objects and by implementation of decisions that don't meet market demands, which is connected with the duration of their life cycle and the scarcity of resources.

Based on the above, it is possible to see how development of overarching research priorities and establishment of a centre for research exchange, bringing together the output of investigations, will allow the global railway community to concentrate its resources in the future into research necessary for railway transport as a whole since such efforts to concentrate findings will cut unnecessary duplication by avoiding needless repetition of similar research.

1. IRRB today and its future goals

1.1 IRRB today

In 2005 a special (ad hoc) working body dealing with railway research – the International Railway Research Board (IRRB) was founded under the initiative of Mr. Yoshio Ishida, Vice-Chairman of JR East, who served as the first IRRB Chairman for 5 years. This action was also the result of strong encouragement from Mr Philippe Roumeguère, UIC Chief Executive at that time, with a view to strengthening the technical support given to UIC members worldwide. More recently during the UIC General Assembly in Beijing 2010 the body was placed under the responsibility of Mr. Boris Lapidus (Director General of VNIIZhT/RZD) and Mr. J-P. Loubinoux (Director General of the UIC).

The purpose of this structure is to keep up with remarkably fast technological development and innovation, and drive the railway industry into adopting state-of-the art technologies. Cooperation on this topic began with "an exchange of views among members" and "discussion about regional development and assistance". At the same time, careful attention was paid to independent research, development activities and individual member intellectual property rights

Since then, the Board has become a platform for sharing output on important common transport related research themes, with investigation into how best to harness the potential of such research for the benefit of UIC members worldwide, through closer cooperation, building knowledge bridges between continents and exploring opportunities for global scale research funding / resources.

The following research centres and railway companies are founding members of IRRB:
SNCF (France), Network Rail (UK), RSSB (UK), DB (Germany), RZD - VNIIZhT (Russia), Korail & KRRI (Korea), JR East, RTRI (Japan), CARS (China), AAR & TTCI (USA), RDSO (India) and QR & CRC for Rail Innovation (Australia).

The standard agenda at IRRB meetings consists of presentations on the latest research projects and achievements of IRRB members among issues highlighted by participants. Plans for conducting joint research are also discussed.

One of the topics for debate since 2008 has been the introduction of changes

to IRRB activity. A proposal was made to create a common database of IRRB activity open to all members and if possible, interrelated with research databases held by relevant members.

The new IRRB Charter and Terms of Reference were approved in July 2010 and in May 2011 respectively. In December 2010 at the UIC General Assembly in Beijing, the IRRB received the status of official working body of the UIC.

The objective for the newly established IRRB was formulated as follows:
"To promote more effectively and efficiently independent and self-supported R&D activities conducted by individual UIC member companies and UIC member research institutes with a view to ensuring this research can contribute to the development of the global railway system, in order to meet the challenges posed by the current changing environment affecting railways today".

The IRRB is a place:

- for railway companies to freely exchange their views on R& D
- for members to discuss the core concepts of railway companies
- to discuss the direction in which railway technology should head
- to discuss the basic philosophy of railway business
- to develop and oversee a process for collaboration on research among
- participating organizations

IRRB mission is *to effectively meet the needs of the railways in the field of research performance, familiarization with innovations and results of research activities conducted in the international community to support the process of enhancing railway transport in order to obtain a competitive advantage, while also contributing to the development and support of the scientific community by helping to find relevant and popular research topics, and customers or consumers of this works.*

1.2. IRRB goals by 2020

The IRRB must ground its long-term research policy on the following principles:

- railway transport is fundamental to social and economic development of UIC regions;
- effective railway transport is a compulsory competitiveness factor;
- improvement of railway operational safety is the top development priority of almost every State followed by modernization of the railway industry, research activity and current operational work;

- meeting the needs of railway customers and members of the scientific community.

Clear determination of this body's path of progression over the next decade is also fundamental to the IRRB development strategy. During this period the IRRB should reach its most productive state to be of most use to UIC members, the research community and society as a whole.

Over the aforementioned period, the ideal position reached by the IRRB would be as follows:

- A network of research organizations performing railway research covering all regions and railway companies - members of UIC and in a position to meet their research needs.
- A well known entity among organizations providing research and funding for projects in Europe and Asia as well as UN organizations.
- A body concentrating all railway research projects and in search of players with the best performance and execution.
- A forum for distribution and coordination of major research projects, commissioned by large regions.
- A source of reliable information about existing research. Free or paid access to research results.
- A body perceived by public standards organizations as capable of providing expert advice for the development of both state and interstate standards as a foundation to quality and safe passenger and freight transport, particularly on issues related to interoperability.
- A source of proposals for the most appropriate railway research topics in agreement with members of UIC, which could serve as a guideline-for the scientific community, as well as for governments, policy makers in the field of railway transport.

2. Outlook: identification of the most effective ways to develop railway transport to enhance efficiency

2.1 Economic factors

Railway transport in the 21st Century will once again be the engine to innovative economic development through both intensification and better performance and the creation and extension of the network (high speed and heavy haul).

The ground therefore needs to be set to nurture this come back of railways as economic catalyst i.e. restoring the macroeconomic role it played in the 19th

Century, grounded in new engineering knowhow and technology.
This period of railway renewal is likely to occupy a good half if not all of the 21st Century.

As the railways undergo this transformation in order to meet ever changing demands of an increasingly globalised economic stage, the sector shall have to invent new transport offerings, equipment, technologies and management processes, which in turn may open the way to:

- Greater production efficiency, exchange and consumption of goods and services;
- Alignment and harmonization of development in different regions of the world;
- Solution of demographic problems and mitigation of imbalance in terms of allocation and standards of living, partly through better mobility;
- Solution for environmental problems and minimization of risks for health and security of people;
- Minimization of power consumption per unit of transportation and preservation of non-renewable power sources.

It makes sense to use such competitive features to their full advantage in addition to creating low-cost railway mobile communications for regions with low freight and passenger traffic density.

Taking into account forecasts on intensification of rail transport in all regions of the world is also a necessity. For example, current long term forecasts, predict substantial container traffic volume growth between Asia and Europe of around 6-8% per year, resulting in a container flow reaching 32 million TEU per year by 2025.

Transit railway traffic volume will mainly be determined by the scale of Euro-Asian trade today - and in the long term - by intercontinental trade.
With regard to current international trade, key factors influencing choice of delivery mode are:

- total value of the transportation cost;
- delivery time of goods;
- observance of the delivery time;
- reliability and security of the goods transport;
- seasonality and dependence on weather conditions.

In the light of the above, railways have the potential to be the most attractive

mode of transport for the delivery of a wide range of goods. One of the main conditions for this to become true is not necessarily a reduction in delivery time, but rather better guarantee of time of delivery, “door- to- door” services and guaranteed and predictable competitive transport tariffs 3-4 years in advance.

Current growth trends in demand for transport should be a catalyst for action. Moreover, in many countries, the process of restoring the previous positions of rail and bringing it to a new stage of innovative development is a significant anti-crisis action.

2.2 Future development in engineering and technology

Given the current economic climate and transport service market needs, innovative solutions are crucial to introduce cost-saving measures and speedier goods and passenger mobility. This means employing new materials, new propulsion systems, new track building techniques and interoperability.

Thus, there will be required providing the macroeconomic basis for spatial and product segments for the preferable use of railway transport

In segments without obvious preferability, creation of effective technologies of interaction of railway transport with other transport modes, providing increase in efficiency and quality of services towards goods owners and passengers on the part of the transport system on the whole will be necessary.

High-speed freight is also necessary to meet railway service customer demand for the transport of high-value goods, as are technologies which allow seamless goods and passenger movement (no operational delays).

Innovative solutions also need to be adapted to suit regional specificities (which may at times require a decision for region-specific development), to guarantee optimization of the socio-economic benefits of railways.

Challenges in the field of passenger transport include development of engineering and technological solutions which can provide rapid, low-cost long and very long haul rail services. This includes, inter alia, detecting means to significantly reduce the cost of both wheel/rail and maglev high speed services; fully integrated transport systems linking suburban and intercity rail services, dramatically reducing the impact of transport on the urban environment.

Research should also aim to facilitate the shift to driverless technologies and

maintenance of technical equipment in regions lacking or with very expensive manpower.

To ensure ecological and safe railways become a reality, it is necessary to draft an international convention on the environmental compatibility and safety of railways, aimed at reducing this mode's impact on the environment (pollution, noise, etc.) and ensuring the health and safety of passengers and those living or working around railway lines.

Finally, innovative solutions to increase economic efficiency are required as are means offer alternative source of train traction (primarily renewable).

Long term trends in railway engineering are today emerging, such as the raising or lowering of infrastructure onto high-rise viaducts or tunnels, respectively or new induction power transmission methods to avoid unsightly cabling.

New engineering and technology form the basis on which railway networks can be extended (for high speed and heavy haul) and can ensure maintained quality as lines are modernized and traffic intensifies.

With regards to technology and the interoperability of railways operating with different gauges work must continue to forge a coordinated and coherent engineering policy, with a view to future passenger and freight volume growth and the creation of unified systems for technical regulation facilitating interoperability.

3. Code of railway transport challenges requiring scientific solutions ("Red Book" of Railway Transport)

In the face of swelling market needs for modern and efficient transport technologies, railway research can no longer afford to take a random course.

The efforts of research organizations and IRRB members should focus on addressing key regional and global issues in railway transport.

Currently however there is no formalized method to rank these core challenges in order of their contribution to the development of rail transport. Furthermore, such a complex method for prioritization can only built on cooperation among major railway research centres, under the auspices of IRRB.

A classification has already been initiated by the IRRB member, VNIIZHT,

headed “The Red Book of Railway Transport”. However, it only covers a small stratum of Russian Railway regional problems and now needs to be extended to cover railways of the whole world. The classification method would be used

to rank both world level and regional level technical and technological problems in order of priority as well as classify problems according to their impact on one of the main objectives of railways: economic efficiency and safety:

- to ensure a systematically scientific approach with regard to the creation of this Code of railway challenges requiring scientific solutions and cooperation among all UIC member research centres it is necessary to:
- jointly elaborate and approve a methodology for its creation
- arrange regular workshops on topics raised within the framework of UIC Research Information Days or other research-related event with UIC member participation;
- develop and implement a software application linking the order of railway challenges as well as enabling dissemination of this information among UIC members, in particular via Internet.

4. Definition of priority areas of research - Standardization

This area of IRRB activity should cover cooperation with regional and state strategic bodies

The purpose of this activity is to establish ties with regional and state strategic bodies such as the European and Asian Bank and provide them with information concerning major areas of future development in railway transport.

This activity is one step towards achieving one of IRRB’s major objectives to be a well-known organization among official bodies and support their activities in developing special research programs in close cooperation with existing advisory councils.

A list of priority research aims was defined, some of which are written below:

- Forming innovative solutions, cost-saving measures and speeding-up of goods and passenger movement, including use of new materials, new propulsion systems, new track building techniques and interoperability.

- Providing macroeconomic basis for spatial and product segments for the preferable use of railway transport

- Creating effective technologies of interaction of railway transport with other transport modes that ensure increase in efficiency and quality of services towards goods owners and passengers by the transport system on the whole.

- Developing technologies for seamless goods and passenger movement (no operational delays).

- Adaptation of innovative solutions to suit regional specificities (which may at times require a decision for region-specific development), to guarantee optimization of the socio-economic benefits of railways.

- Creating high-speed freight for transport of high-value goods.

- development of engineering and technological solutions which can provide rapid, low-cost long and very long haul rail services. This includes, inter alia, detecting means to significantly reduce the cost of both wheel/rail and maglev high speed services.

- Creating fully integrated transport systems linking suburban and intercity rail services, dramatically reducing the impact of transport on the urban environment.

- Research to facilitate the shift to driverless technologies and maintenance of technical equipment in regions lacking or with very expensive manpower.

- development of innovative solutions to foster ecological and safe railways reducing this mode's impact on the environment (including use of alternative technologies) and ensuring the health and safety of passengers and those living or working around railway lines.

Of course, this list should be revised in the light of future new information or ideas.

Given the vast number of possible work areas, this list aims to help to official state bodies and regional strategic bodies as they draw up research call programs. These bodies also have the option of requesting IRRB to provide such information for making new research calls.

Increasing globalization means that more attention needs to be paid to interoperability and common standards applicable to future railway transportation, which ties in closely with what has been written in previous IRRB documents.

5. Review of scientific potential (Code of global scientific resources in specific areas)

One of the strategic goals of IRRB is the evaluation and monitoring of worldwide scientific potential in rough-cut areas:

- Infrastructure (heavy haul and high-speed);
- New rolling stock,
- New propulsion systems,
- Economy and management of railway transport,
- Operation of railways,
- High speed traffic,
- Suburban traffic,
- Freight traffic,
- Safety and security,
- Environment,
- Extreme weather conditions impacting on rail,
- New materials for railway transport (e.g. including materials developed on the basis of nanotechnologies),

In this context, the following must be determined for each theme:

- Main scientific centres
- Scientific schools
- Opportunities to merge efforts of different scientific centres and schools for finding complex tasks solutions.

This work will be conducted on a permanent basis.

6. Development of knowledge database and monitoring of on-going research activities. Review (benchmarking) of best practices and problem solving

IRRB will also set up and maintain an up-to-date knowledge database containing research output in the areas defined in paragraph 5, in association with dedicated research centres and representatives from scientific schools. The database will be updated through monitoring of current research activities.

Assessment of the available knowledge, as well as problems and needs of members to support processes of identifying and ranking of critical issues in order to recognize similarity in the problems and research needs, as well as to determine the need of standardization and common regional and global approaches must be carried out in the frameworks of this data base. Furthermore, comparative analysis of the best solutions for each scientific problem shall be determined with a view to dissemination within UIC.

Support and recommendation both on dissemination and ways to disseminate results shall be carried out in coordination with organization of the World Congress on Railway Research (WCRR), which is a global conference focused on railway research and developments.

The most important tool forming part of the database development on current and past railway research and best practices will be the UIC Research Portal linked to UIC and IRRB member databases on railway research projects and developments.

7. Scientist, laboratory, world-class research centre incentive. Elaboration of a grant system for promising research

1. Development and determination of " IRRB ratings " referring to researchers, laboratories and research centres on the basis of objective criteria (publication activity, amount of implemented and defended results of scientific research and other scientific indicators).

2. Elaboration of a grant system for promising research taking into account IRRB ratings.

3. Introduction of "IRRB world-class status" for scientists and research centres, taking into accounts the level and change dynamics of their ratings and grant activity.

4. Establishment of a Global Award for railway research innovation, which, based on UIC’s core mission should encourage use of railway transport on a global level now and in the future. Given the challenges faced by railways today and tomorrow, innovation and step change are required.

Categories for the Global Award in the field of railway research innovations will be presented for rail-oriented research on innovation with a proven implementation in the following areas:

- Traffic safety and security (including signalling)
- Sustainable development (including energy issues, noise, vibration, environmental pollution)
- Railway system (rolling stock, infrastructure and their interaction (communication))
- Railway freight
- Customer Services (including new business models)
- Reduction of costs (increased competitiveness).

Achievement of this goal relies on continuous assessment of IRRB and work progress, as well as cooperation among railways and industry with research organizations, which in turn requires elaboration of key strategic implementation indicators.

Conclusion

Strategic implementation will allow IRRB to becoming a leader in creating direct links between research organizations and railway companies and authorities responsible for transport development. The latter will contribute to an organized exchange of information on ongoing research activities, reduce time and cost for development and implementation of innovations, and ultimately accelerate the pace of rail transport development.

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