




A Joint Strategy for European Rail Research

2020

Towards a Single European Railway System






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UITP

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Contents

This text has been prepared with the joint effort of the UNIFE and UIC Research departments, UITP, CER, ARRC and ERRI.

1. A COMMON VISION FOR RAIL IN EUROPE

1.1 Introduction

A successful, larger and more integrated Europe for the 21st century depends essentially on the availability of efficient transport systems supporting sustainable economic growth and social development. Transporting passengers and goods by rail is a major instrument to combat congestion, pollution, global warming and traffic accidents. All these negative externalities undermine the efficiency of European economy and the health of future generations.

The enlargement of the European Union and the globalisation of economy have fostered the growth of an international transport market, now outpacing economic growth. The rail sector today faces the demanding challenge of accommodating higher transport volumes, a result of transport growth, and of policies favouring modal shift.

Innovating and harmonising products and technologies are a necessity for the rail market to deploy all its potential, and for its stakeholders to deliver cost-effective services for intermediate and final clients. **Rail transport in Europe is a future-oriented industry and is striving to offer an even more attractive, affordable, safe, clean, competitive and reliable transport mode.** Internal reforms and political commitment have helped the rail sector to overcome the transition forecast by Louis Armand, UIC Chairman, who wrote "Rail will be the transport mode of the 21st Century, if it can only survive the 20th".

Political stakeholders in the EU and Member States support the thrust to innovation by the European Railways and the Rail Supply Industry [1]. Technical developments and EU policies go hand in hand to improve the operating efficiency and customer service quality of the Community's railways. The EU is showing its commitment to innovation through extensive legislation and measures encouraging modal shift. For example, introducing a new regulatory framework for market access, encouraging service technologies, enhancing the infrastructure capacity, promoting charging and funding policies for the infrastructure and a better level-playing field between competing modes.

Most particularly the European Union has approved a Directive on Interoperability for Conventional Rail, which creates a new regulatory framework to enhance the attractiveness, competitiveness and efficiency of rail operations and reduce operating, system and production costs. This Directive marks an important step forward for the European Railways and the Rail Supply Industry, opening the possibility to the creation of a **Single European Railway System without technical or operational barriers.**

This process allows for an enlargement of the market to European or Pan-European dimensions. **In addition, it will release economies of scale and deliver high-quality international services across Europe for both passenger and freight traffic.** This is a demanding process as it takes place within a severly competitive framework and against the background of important financial constraints for the rail sector and for public authorities.

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[1] In this document the term "Railways", refers to Railway Companies (including local operators) and the Infrastructure Managers. The term "Rail Supply Industry" refers to the rolling stock constructors, sub-systems and component suppliers. In some cases, "Industry" could refer to the whole rail sector.

A well functioning single market with freedom of movement for both freight and passengers will not be possible if bottlenecks affect traffic fluidity. Such bottlenecks are to be found in local and regional levels in virtually every European urban area. Therefore, **relieving congestion by providing good, speedy and efficient rail mass transit in urban areas** is not a local or regional matter, but it is also of utmost importance for the overall vitality of the European single market.

Innovation and interoperability are key success factors for European Railways and the Supply Industry. **Targeted, cost effective and well-managed collaborative research** is a key instrument to extend and ensure acceptance of interoperability across the entire European rail industry.

The Mission Statement established by the European Railways and the Supply Industry (UNIFE, UIC, CER and UITP) in 1998, which remains fully valid today, is the common starting point for the **Joint Strategy for European Rail Research presented in this document.**

"The railway industry will provide, safe, attractive and affordable transportation and transport products for passenger and freight users. We will operate our companies viably according to market principles. We will create conditions for a single market for both rail equipment and services. We will encourage growth in the market share of the rail mode whilst stimulating increases in system capacity and promoting the development of urban networks and the pan-European rail system"(2).

(2) UNIFE, UIC, CER and UITP Mission Statement 1998

1.2 Objectives for an Interoperable Railway System

The principal objectives of the proposed interoperable railway system in Europe by the year 2020 are:

- **For rail to achieve a 10% market share of passenger traffic in the EU** with no detrimental environmental impact. This represents a doubling of passenger kilometres within less than twenty years (Based on Eurostat/UIC Statistics);
- **For rail to achieve a 15% market share of freight traffic in the EU** with no detrimental environmental impact. This represents a tripling of ton kilometres within less than twenty years (Based on Eurostat/UIC Statistics);
- **A threefold increase in productivity** (UIC Strategy);
- **Elimination of avoidable fatal accidents within proposed interoperable European railway system;**
- **A 50% gain in energy efficiency** over vehicle or product life cycles;
- **A 50% reduction in the generation of pollutants** over the life cycle of rail industry products and services;
- **An increase in network capacity to accommodate the traffic projections given above.**

EU Passenger Transport 1000 Million pass-km	**1970**	**1998**	**2020**
RAIL (1)	217 (10%)	290 (6%)	**676 (10%)**
TOTAL	2157 (100%)	4772 (100%)	**6760 (100%)**

(1) Does not include tram and metro transport. In 1998, tram and metro transport was 50.000 Million passenger - km

EU Goods Transport 1000 Million tkm	**1970**	**1998**	**2020**
RAIL	283 (21%)	241 (8%)	**784 (15%)**
TOTAL (2)	1340 (100%)	2870 (100%)	**5230 (100%)**

(2) Including: road, rail, inland water-ways, pipelines and sea (intra-EU)

Source: EUROSTAT / UIC Statistics, for 1970 and 1998 figures

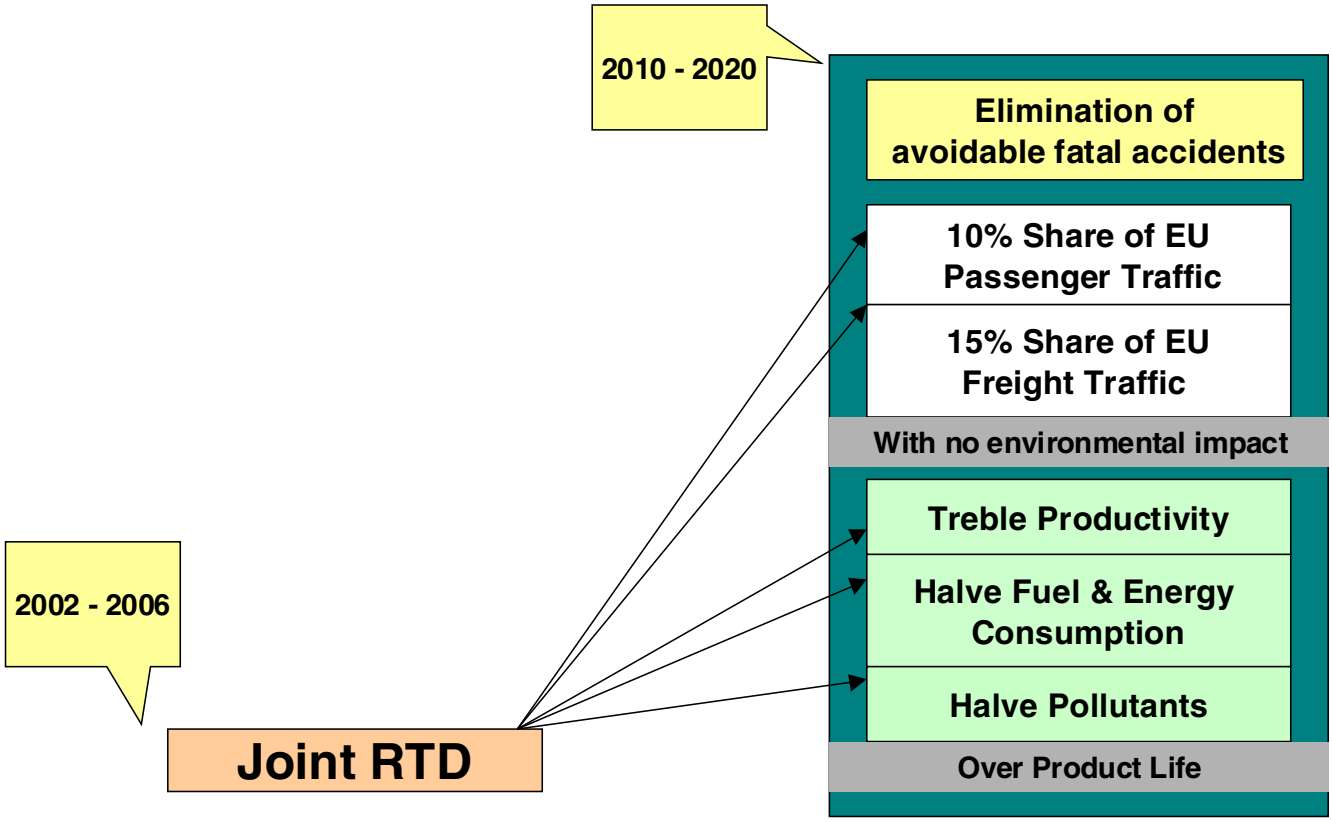

Figure 1.2 – The objectives for an interoperable railway system

These objectives are ambitious but achievable. They have the potential to transform the entire European railway industry and its long-term prospects into a sustainable and successful transport mode for the 21st Century. **To succeed, politicians, public authorities, railway companies, infrastructure managers and the rail supply industry have to work together** and create the railway transport system envisioned in the Helsinki Accord of 1997.

The «railway transport system» is a complex entity and an intrinsic element of the Pan-European transport system as defined during the 3rd Pan-European transport conference in Helsinki 1997, and includes:

- the rail infrastructure network;
- nodes such as terminals, stations, travel centres, ports and airports which interconnect the different transport modes;
- IT-systems, information systems;
- rolling stock, loading equipment and goods transferring equipment;
- the structure of public authorities and transport enterprises and rules for competition, infrastructure package, etc...

all of which will be drawn into the research equation.

Facts about the European Railways & their Suppliers:

European Mainline & Local Mass Transit Operators:

- Total turnover EURO 75 Billion p. a.;
- Provides employment for 1.000.000 persons;
- Invests EURO 250 Million p.a. of its own resources in Research & Development.

European Rail Supply Industry:

- Turnover EURO 25 Billion p.a.;
- 130.000 direct employees and 250.000 total employment;
- 60 % World market share and a net exporter;
- Invests EURO1000 Million p.a. of its own resources in Research & Development.

1.3 The Railway's Perspective

The Railways must increase their market share as transport demand expands and regulatory policies change. According to market opportunities railway companies' business strategies aim at competition with national and international transport operators or cross-border co-operation partnerships between market actors.

Railway companies need to offer a full-range of transportation services either directly or through the intermediary of partnerships. Partnerships will allow them to attract private capital and develop a global service with for example the creation of **"one stop shops" allowing the customer to buy "door to door" transport or to conclude a freight routing contract with only one forwarder.**

These business strategies require the availability and use of information technologies and the sharing of common goals and technical infrastructures between all railways, which may imply the option of **dedicated joint ventures with other transport modes leading to the provision of new and attractive services**.

In an increasingly competitive environment and with scarce resources, purchase of modular material and platform products will be a key to curb investments, operation and maintenance costs (LCC). Stansardisation, to a certain extent, is the key for future ability to compete with other modes.

1.4 The Rail Supply Industry's Perspective

Engaged in a global consolidation process, the rail supply industry is preparing itself to work in a highly competitive market without national boundaries. Relations between rolling-stock constructors and their sub-suppliers are changing and initiatives, such as the development of e-business, must be quickly taken on board. The number of Small and Medium-sized Entreprises (SMEs) is decreasing but they are a source of innovation and they are an important link in the supply chain and they should be recognised as such.

The Rail Supply Industry invests EURO 1000 Million each year in research and development in products and services. New production technologies, materials, signalling, telecommunication and information systems are the result of this effort. Product families and platforms will bring reduced development cost and time. The potential impact of system standardisation cannot be sufficiently stressed .

Innovation in rolling stock and infrastructure, and the maintenance of both, should lead to an increased perceived quality of the vehicle, comfort and safety. Innovation in fixed installations (infrastructure and signalling) should lead to a perceived enhanced volume and quality of services and system safety levels. These efforts should be encouraged. SMEs are also playing an important role in this respect.

Integrating planning, stabilising spending, outsourcing and partnering are current examples of the industry's efforts in building good relations with the railway operators. Information on the building and operation processes is necessary for these efforts to be successful. The industry is willing to take on its responsibilities in fields such as design, customer support and research.

1.5 The European Transport Policy

In addition to the requirements of the railway business, joint rail initiatives take into account the development of the European Transport Policy and the legal framework.

Current European Transport Policy is aimed at providing a Single European Railway System as an intrinsic part of the European Intermodal Transport System and creating a level playing field for all modes. One of the principal objectives of the European Union must therefore be to **accelerate the development of operational and technical interoperability, and to enhance safety and environmental performance** as required by EU and international legislation.

The dissemination, transfer and adoption of knowledge and technologies is essential for **Small and Medium-sized Enterprises (SMEs),** in order to strengthen the technological innovation capabilities of the EU. The final result will lead to an increase of technologically advanced businesses.

Rail is a major industry within the European Community. With a 60% world market share, the European Rail Supply Industry is a **world leader** in many areas of rail technology and successfully competes with other equipment suppliers in a wide range of markets. The future of the rail industry at the operating, maintenance and supply levels requires the **opening-up of national markets and the removal of barriers of protectionism or highly individualised practices on technical, operational and commercial levels**. Much of this can be achieved through the widespread acceptance and adoption of the concept of interoperability, standardisation and modularisation.

Innovative methods of financing are being created specially for projects with long life cycles which can be made more affordable through lease, build, own, operate and transfer mechanisms.

2. A JOINT STRATEGY FOR EUROPEAN RAIL RESEARCH

2.1 Unity of purpose

Rail transport in Europe contributes to the delivery of the EU Common Transport Policy and must therefore become an attractive, affordable, safe, clean, competitive and reliable transport mode. To fulfil these ambitious goals a mechanism is required. The proposed Joint Strategy for European Rail Research has been developed by the European Railways and the Rail Supply Industry as the means to achieve this task, expressing their commitment to the sustained revitalisation of rail through innovation.

The Union of European Railway Industries (UNIFE), the International Union of Railways (UIC), the Community of European Railways (CER) and the International Association of Public Transport (UITP) support this initiative.

Within this strategy the core concept of interoperability is the catalyst to trigger focused and practical joint research across the entire European rail industry. Interoperability will bring about profound changes to the way the industry compares with competing modes of transport on the basis of cost, quality and choice on merit.

A Single European Railway System brings benefits to all rail users, railways and suppliers through a 'multiplier effect' resulting from the implementation of new research findings and the deployment of innovative technologies on a European scale. Research is crucial to developing a wholly transformed European Rail Industry.

2.2 Why is Joint Research on Interoperability needed?

Common collaborative research on interoperability will lay down the practical conditions for the creation of a truly continental-wide railway system. This will inevitably expand the scale of viable, competitive and reliable operations while closing the gaps in performance with other advanced railway systems, such as in the USA for freight and in Japan for intensive passenger services. Research on core projects implementing interoperability will also create the conditions for sustainable mobility in Europe and provide an attractive, affordable, safe, clean, competitive and reliable transport system able to cope with the challenge of the foreseen increase transport demand.

Joint Research will also provide grounds for setting up industry standards for **improved modularity, time-to-market deliveries and proven technology**. It will enable the rail supply industries, as well as the railways, to develop common tools that will aid profitability and innovative products, while reducing high costs incurred because of **duplication in research and limited serial production**.

Joint research is also likely to determine the path for the future development, innovative processes and competitiveness of the Small and Medium - sized Enterprises (SMEs) whose contribution to the sector in terms of technological adaptation or revolutionary concepts is key for the future dynamism of the industry.

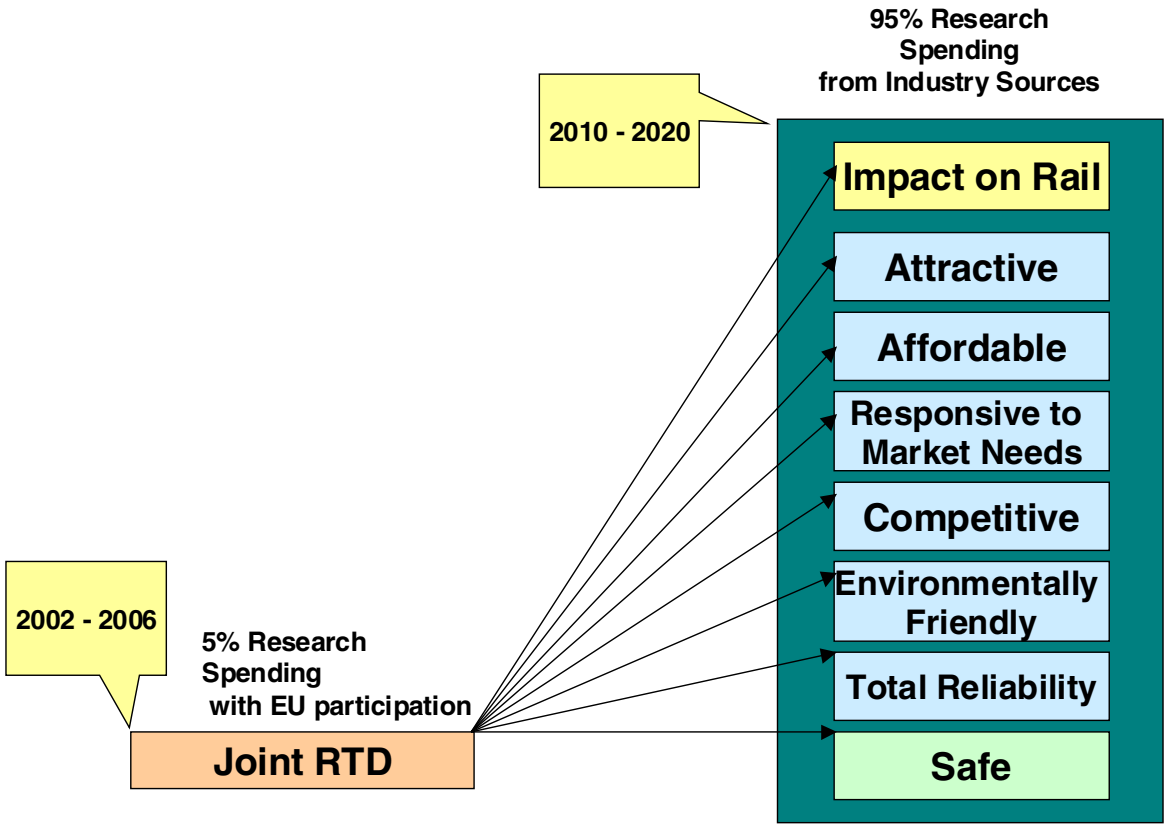

Figure 2.2 – The vision – impact of collaborative research

2.3 The Multiplier Effect applied to Joint Rail Research

Joint research at a pre-competitive level by railways and supply industry is likely to generate positive knock-on effects in the form of further technological and commercial enhancements and additional benefits for the whole railway sector.

Targeted pre-competitive research aimed at establishing a Single European Railway System - though limited both in scope and budget - is likely to produce a multiplying effect on future research projects that can be developed either at the collaborative or competitive level. This process will foster further competitive innovation while encouraging both continuous improvements of deliverables and eventual breakthrough discoveries.

The railway industry strongly believes that this "multiplier effect" will materialise once the path of research can be drawn with certainty. Investment in further projects will inevitably follow. However, joint kick-off research in key areas of the railway system is necessary to unchain this effect.

Knock-on effects are most likely to appear in the following areas:

1) Creating the infrastructure management systems to plan and operate trains answering customer requirements;
2) Enhancing the product and service quality of rail freight including technical and operational solutions for cost effective operations fully able to compete with road transport ;
3) Improving the regularity, capacity and speed of passenger trains across large parts of the European railway system.

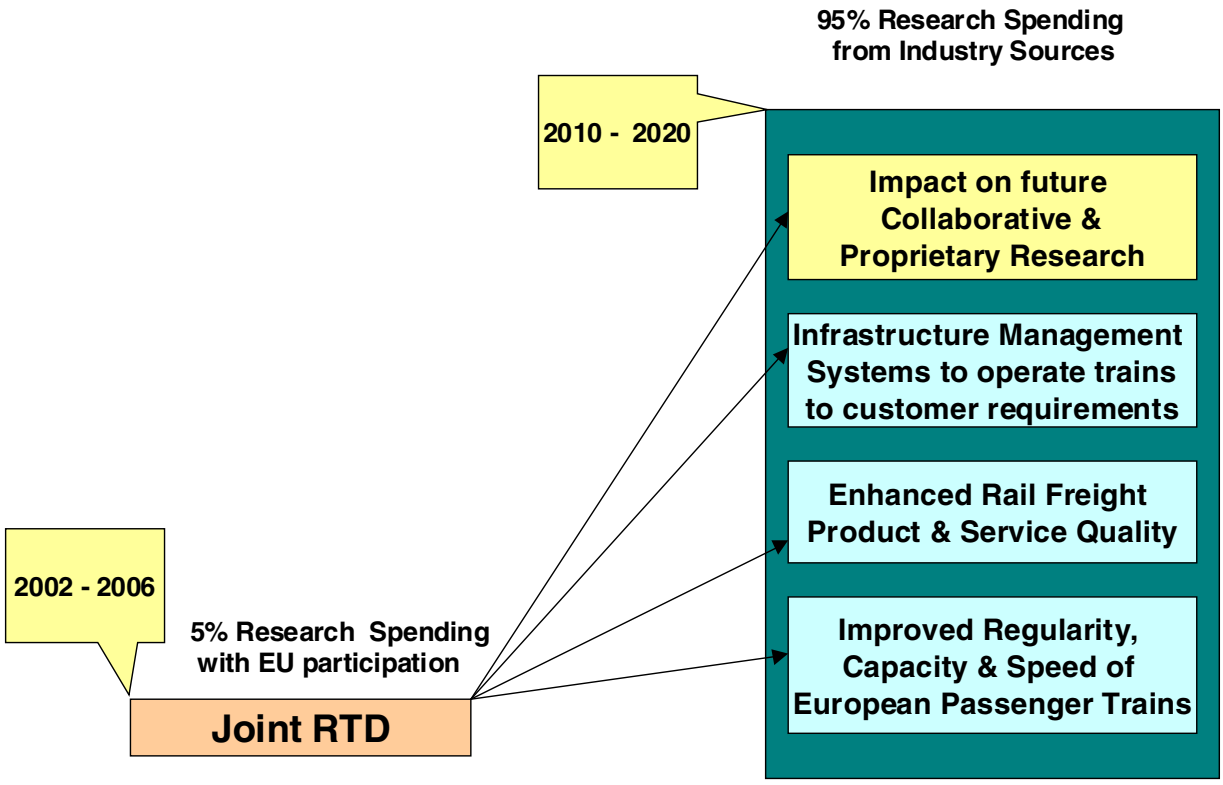

Figure 2.3 – The Multiplier Effect of Joint Research on Interoperability

5% Collaborative research is likely to generate up to 95% knock-on collaborative and proprietary research with little risk of costly duplication

The initial "multiplier effects" on joint research projects are likely to materialise within the next decade. But some long-term initiatives, which are capable of forging the different national networks into a truly pan-European railway system, are also included in this document. Failing to lay these cornerstones would endanger the prospects for future competitive and collaborative research.

3. OPPORTUNITIES AND COMPETITIVE PRESSURES

3.1 Opportunities

The European rail network is a Europe-wide but remains nationally or even locally orientated. It is already a safe and energy efficient transport network, capable of accommodating vast amounts of passenger and freight traffic at increasing speeds, with **minimal environmental impact** per unit transported. The rail transport mode is able to operate using electrical energy produced from a variety of generation technologies, and thereby is less dependent on liquid hydrocarbon fossil fuels for traction than competing modes.

Rail has the potential to significantly **improve upon current train speed levels** and can build on earlier notable technical European successes, such as: existing high-speed train families, tilting train technology, innovative electric and diesel traction technology packages, light rail vehicle (LRV) and metro product ranges and advanced signalling and train control systems.

The development of rail services to **move passengers to and from major international airport hubs** gives rail another dimension to exploit its capabilities. The success of shuttle type services between airports and cities could be further enhanced by recognising that major airports are significant generators of passenger and freight traffic operating on a wider domestic and international level. The examples of Paris - Charles De Gaulle, London - Heathrow Express and Amsterdam – Schiphol, point the way to what could be further developed.

High speed lines are replacing short flights (under 500km). The rail transport mode is now the natural airlines' partner for international flight connections. Handled in an intelligent manner rail can make a considerable contribution to the reduction of overall noise levels for neighbouring communities by replacing the excessive use of night flights, etc.

Commensurate improvements in the freight sector are now needed to secure the additional traffic flows foreseen.

European Rail Technology Firsts

- AC Traction Technology for Electric Locomotives;
- AC Traction Technology for Diesel Locomotives;
- 300 km/h High-Speed Cross border Train Networks;
- 50Hz High Voltage Electrification;
- Fibre Optics for Signalling and Train Control;
- Tilting Technology;
- European Rail Traffic Management System (ERTMS).

The industry also has major technical and operational expertise, but needs to absorb and use new technologies and methods from other industries to become much more competitive, cost-effective and more customer and market oriented.

3.2. Competitive Pressures

Rail is under tremendous competitive pressures from other modes, for both, passenger and freight traffic for short, medium and long distance routes. In the freight arena rail is threatened by intensive road, water and pipeline competition. Rail has lost market share as service reliability and product deficiencies have become more pronounced compared to other modes.

Traditional levels of protection enjoyed by the rail industry are being removed as it shifts towards increased liberalisation. These measures will induce a move to even greater cost effectiveness but will also probably reduce the ability of the industry to continue to operate using orthodox technology, systems and practice.

Barriers to Success

- Lack of common standards;
- Lack of harmonised regulation (e.g. for safety);
- Network saturation at nodes;
- Noise and vibration;
- Pressures on first cost of equipment and over-capacity in manufacturing;
- High fixed costs of operation;
- High cost of infrastructure investment and maintenance;
- Ill-defined relationships between public authorities and railway undertakings.

3.3. Rail Competitiveness and Sustainable Growth

The entire European rail industry must become much more competitive across the whole spectrum of activities in which it is involved. This aspiration must be achieved within established and developing policy frameworks and initiatives, aimed at **securing sustainable levels of growth without long term detriment to the environment and the population.**

Rail has, through its green attributes, the potential to move more people and cargo with high levels of energy efficiency, low noise and emission levels, greater safety, convenience, lower cost and higher reliability than many other modes. The ability to realise this potential relies on a mix of new technologies, management and operational methods combined with a greater focus and attention to customer requirements. Despite this, there is still room for improvement on prevailing levels, as operational speeds are increased and larger volumes of traffic are moved.

3.4. Social aspects

Rail industry employees are naturally concerned about the social implications of competition and restructuring. The improved commercial performance of rail operations will stimulate the **creation of new high quality jobs.** Many of these, will relate to the increasingly customer-oriented nature of the service provided. Furthermore, new scope for job creation could be linked to the task of improving the attractiveness and comfort of the rail mode of transport.

New skills and qualifications will be required for railways employees to function in an international working environment and provide efficient services across borders. Therefore, new career opportunities and training will be created to respond to the demands of a Single European Railway System.

Enhanced attractiveness and performance of the rail mode can be translated into more environmental-friendly mobility for people and goods and **it will improve the overall quality of life**. Intermodal transport must be encouraged to achieve an efficient transport chain.

4. THE COMMON RESEARCH PROGRAMME

4.1 General

The Joint Strategy for European Rail Research is a rolling programme, jointly undertaken by the Railways and the Rail Supply Industry (UNIFE, UIC, CER and UITP). This programme identifies essential large-scale projects, clustered around a common theme and will secure real, tangible benefits for the industry in terms of enhanced commercial competitiveness and technical performance.

This Strategy relates to work supporting and anticipating European Commission directives and policy initiatives and aims to accelerate the implementation of the "Rail Package" and the Directive on Interoperability for Conventional Rail. It therefore supports the evolving work of the joint harmonisation bodies such as AEIF, CEN, CENELEC and ETSI. These must be given real relevance through the **EU's adoption of research efforts, programmes and initiatives that cannot otherwise be supported by the rail sector at a national or European level.**

The Directive on Interoperability for Conventional Rail aims at **setting the regulatory framework** necessary to enhance attractiveness, competitiveness and efficiency of rail operations and to reduce operating, system and product costs. It intends to harmonise the specifications of rolling stock, signalling, command and control and telecommunication systems, operating rules, maintenance and repair and the assessment of conformity.

Interoperability is the catalyst to achieve the key objectives set out in this document. Rail transport in Europe must become an attractive, affordable, safe, clean, competitive and reliable transport mode on a European scale. It is intended to make rail products, systems and services more compatible, competitive and acceptable across the European rail networks to support the ambitious growth in passenger and freight traffic envisaged. Interoperability will reduce the cost base of the constructors and operators by using internationally recognised codes for the specification, design, certification, manufacture, testing, commissioning and deployment of rail products, systems and services. This will support the development of competitive rail services for passenger and freight traffic at domestic and international levels.

Interoperability will endow the railways with greater freedom to operate train services without the delays and impediments created by reliance on national codes for manufacturing, certification and operation. **It will allow rail to operate with freedoms that are enjoyed by competing modes** such as air and road transport, which are governed by the sort of recognised codes of interoperability. The further development of competitive rail services is reliant on the acceptance and implementation of the concept of interoperability

This research, technological development and demonstration programme is estimated **at EURO 40 Million per annum** with support divided equally between the rail sector and the European Commission in the period 2002-2006. The 'returns' on this investment will be secured throughout the period 2003-2010 and beyond.

4.2. Research Priorities and Support Fields (2002 - 2006)

Summary

Research Priorities

1. Conditions for Interoperability

(Concept development and demonstration of the benefits of harmonised passenger and freight services to speed acceptance of the proposed Conventional Technical Specifications for Interoperability measures).

- Interoperable Operations, Rolling Stock and Infrastructure;
- Integrated Transport Strategy;
- Improving Passenger and Freight Services.

2. Development of Telematic solutions

(Proposed Interoperable IT & Signalling Systems presuppose the creation of interconnected distributed databases on a European scale. Protocols will need to be developed, demonstrated and proved to the many actors involved in their introduction).

- Inter-connected telematic applications, accessible for freight and passenger transport clients, linked to other modes;
- Fail-safe train positioning and traffic management linked to the control system, fleet maintenance optimisation;
- Distance monitoring and dynamic management of trains, wagons, equipment and cargo, including network interoperability aspects of brake control and traction performance;
- European-wide ambient intelligence infrastructure in support of smart personalised travel information and services and competitive-edge freight services, etc...;
- Data to be presented on terminals in a standardised and comprehensible form.

3. An Holistic Approach to Safety

(New product assessment and approval is becoming more and more expensive and time consuming. For Interoperability to generate real benefits by accelerating conformity acceptance, new approval techniques and facilities need to be introduced capable of maintaining existing high levels of safety).

- Harmonised validation systems for safety assessment;
- Define the mechanical and operational aspects of rail systems analysis;
- Construct a database to validate the expert choices, comparing them with service feedback;
- Guarantee exhaustive levels of assessment while protecting the railway community from over-specification.

4. Retaining the Environmental Advantages of Rail

(Rail traffic must be able to double without damage to the environment. Europe's citizens want heavier freight and faster passenger trains but without the resulting noise, air and EMC pollution impacts.)

- Developing noise attenuation techniques appropriate for different networks;
- Noise and vibration footprints in comparison with other modes;
- Reduction of CO2 and toxic emissions;
- Analysis of electromagnetic emission solutions;
- Recycling of materials used in the manufacture and refurbishment of rail vehicles;
- Energy efficiency and alternative energy sources.

Support Fields

(Rail will be included in programmes initiated by other transport modes)

5. Innovative materials

6. Production methods

4.2.1. Conditions for Interoperability

A Interoperable Operations

The timely implementation of the Conventional Interoperability Directive will demand the resolution of a number of apparently mundane **variations in operating practise** between the member states. Problem resolution by the demonstration of innovation could accelerate the agreement of previously divergent technical specifications. Work is envisaged in the fields of both procedures and devices to enhance harmonisation and automation (i.e. automatic identification of vehicles and other equipment/functions to improve productivity).
Interoperability will also demand new approaches to the **integration of personnel** employed by the different actors engaged in the creation of a Single European Network Railway System. They will be required to master new languages, operating procedures and cultural influences in addition to the new technology.

B Interoperable Rolling Stock

In order to gain the maximum economic benefit from forging a Single European Railway System, it is essential to restore the competitive balance of the rail mode by capacity improvements. In the freight sector this can be partly achieved by the use of **faster vehicles with heavier loads**. However, for this strategy to succeed, collaborative research into the implications of increases in axle loads on brake systems and suspensions is vital. This will be followed by research into improvements in wheel and bogie technology to meet specific interoperable requirements. In the context of new urban trends including: urban sprawl, scattered housing, shopping and employment patterns, rail patronage increases will only be achievable if seamless journeys are offered. This in turn will require special **dual system rolling-stock** such as tram-trains.

C Interoperable Infrastructure

The timely implementation of the Conventional Interoperability Directive will secure co-ordination in infrastructure improvements and maintenance standards between the member states. Problem resolution relating to cross-border services may be aided by technical and economic research into the **optimisation of infrastructure and vehicle gauges** across the Single European Railway System. Research has to be encourage into cost effective remedies for the wide range of catenary geometry and noise abatement measures adopted by the national and city networks. Some possibilities include:

- Improved understanding of Infrastructure elements through modelling and other techniques;
- Optimisation of Infrastructure components and maintenance;
- Development of Infrastructure monitoring and diagnostic systems;
- Optimisation of track repair techniques;
- Increased infrastructure loading (axle load, overhead line capacity, ...etc);
- Line capacity management (increased train frequencies, ...etc);
- Optimisation of working methods (structure, management and computerised expert systems).

D Integrated Transport Strategy

The ability of passengers and freight users to identify and to utilise options and technologies to move seamlessly between modes of transport in a journey or transit is limited. This works against the use of rail. **Savings in time to passenger and freight users** could be significant if whole journey sequences could be planned and implemented with high levels of reliability. This in turn implies access to information for planning and journey monitoring to accommodate any disruption to the planned transit. All of these factors apply in terms of domestic and international service structures and service provision.

The example envisaged relates to freight operations, but seamless transitions are of equal importance to passengers. A valuable demonstration removing the time penalties linked to mode transitions between Metro, Light Rail and Conventional Rail, could also be envisaged.

Rail transport does not develop in a vacuum. Its size, shape and success will also be influenced by constantly rising demands for **better service quality**. Customer and operator satisfaction is an ultimate goal, longing for advanced service technologies: knowledge based remote diagnostics and condition based preventive maintenance, fleet management with on demand services, interactive passenger information and entertainment from ground based server stations, are some of the core technologies for joint development.

To validate this position, a series of demonstration projects are foreseen to show how **multi-modal options** are potentially as attractive in terms of product, service, cost and reliability, when compared to competing offers. This, taken together with the encouragement of cross border solutions for service, system or product provision linked with the improvement and simplification of inter-change nodes, will explore the key issues in this area. They will aim to achieve innovative means of passenger and freight service delivery, using rail and other modes where this is appropriate and effective.

In order to improve the attractiveness of rail for both passenger and freight users, there is a need to **improve information** on the availability and capability of services, and provide technology that will make for seamless transitions between modes. The added value in terms of time savings and movement patterns that align with users needs, rather than in response to supply side provision, suggests that some significant benefits could accrue in this area. The key issues are:

- To demonstrate the existence of multi-modal options that are attractive in terms of product, service and cost when compared to competing offers;
- The encouragement of cross-border solutions for a single supplier or industry;
- The automation, simplification and cost reduction of terminal infrastructure.

The objective must be the development of **innovative means of freight transport and distribution, able to outperform road-only services,** on service, cost and product expectations.

E Improving Passenger and Freight Services

There is a more general need to support Interoperability efforts by the identification and communication of best practise in cross-border and intermodal operations. With the large number of short and long haul cross-border passenger projects envisaged over the next two decades there is the real danger of an explosion in divergent solutions. Leading by example and the free exchange of knowledge may be more likely to yield the desired economies of scale than regulation.

Therefore, research is envisaged into **Europe-wide knowledge systems and data exchange** relating to passenger handling, market research, traffic scheduling, booking of paths, border crossing procedures, etc.

4.2.2. Development of Telematic solutions

The actors in the railway field are developing numerous applications based on new technologies with the aim of improving the competitiveness and attractiveness of the rail system. Previous research work to evolve standards for ERTMS/ECTS and GSM-R being at the heart of these developments. **All these applications must now be capable of being inter-connected and accessed** by the freight and passenger transport clients, in certain cases. All this data needs to be presented on the terminals of the responsible individuals in a standardised and comprehensible form, or Europe's railway network will become a patchwork of incompatible one-off solutions! The speed of technical change and the explosion of information providers compound the urgency of the integration effort.

It is therefore necessary to define**,** through targeted research, a **telematics network capable of future development** in order to handle all these numerous applications. This research project will enable the use of technologies developed in other sectors, in particular the Ambient Inteligent concept, while adapting them to the particular needs of rail.

The scope of the work must include all telematics applications appropriate to the railway sector:

- Fail safe train positioning and traffic management in connection with the control system.
- Distance monitoring and dynamic management of trains, wagons, equipment and cargo, including network interoperability aspects of brake control and traction performance.
- European-wide ambient intelligence infrastructure in support of smart personalised travel information and services and competitive-edge freight services, including intelligent end-to-end applications based on flexible multiparty arrangements, to induce increased rail mode usage.
- Real-time distance monitoring and seamless maintenance equipment including multiparty arrangements and control/ commissioning/ certification mechanisms.
- Creation of independent international support databases to allow the railways and their suppliers to draw on common aspects of operations, construction, fleet management and approval processes to allow the refinement of virtually all processes and techniques in the rail sector. Techniques such as Network Mapping and Electronic Asset Registers may be particularly significant. The ability to pool and exchange information more readily and at lower cost will offer a significant advantage across the entire spectrum of railway interests.

Such networks must also be capable of being connected to the networks developed by the other modes: truck, air and maritime, in order to be able to offer a truly seamless intermodal service to all transport users.

4.2.3. An Holistic Approach to Safety[1]

Rail is an inherently safe mode of transport for passengers and freight and needs to maintain this position without any loss of commercial competitiveness. The rail industry needs to address the integration of key issues such as large-scale traffic growth and its accommodation on the network, the integration of higher train operating speeds, traffic control and signalling.

[1] 'Holistic Safety' means tacking rail safety as a 'global totality' rather than individual elements.

Changes in vehicle specification, manufacturing and materials have an impact in vehicle design, levels of protection to occupants or contents and fire and crash resistance. The **alignment of national codes, governing safety in operations, design, certification, testing, acceptance and maintenance,** to support the move to greater interoperability will be required to underpin research and technology development in this sector. Research will also continue to make an important contribution to the definition of these supra national codes which will be equally applicable to Conventional Rail and Mass Transit.

The need to move **greater numbers of trains at increased speed on common infrastructure** will demand new methods for operations. EU legislation and system users will require enhanced levels of safety. In addition, the European railway system is undergoing two major changes: separation of the infrastructure management activity from that of train operation and the opening up of the rail network to new entrants.

This demands **a new global or "holistic"' approach to the safety** of the entire rail system to ensure that any actor in the European railway system, along with personnel and hardware, is able to maintain the same high level of safety achieved prior to these changes in relationships.

There is the strong temptation to modernise the methods that enabled the existing high level of safety to be attained - unequalled to date by other modes – and replace it immediately with a risk assessment methodology. What is proposed is research into a more cautious and evolutionary **two-stage approach** to meet the open access and harmonisation objectives:

- **During an interim 10-year period**, the current validation systems for the safety assessment of on-board command control sub-systems are maintained, and harmonised during the expert work in drafting the conventional rail TSIs.

  In parallel, this key research project will :
  - define the (mainly) mechanical and operational aspects of rail systems analysis;
  - structure and classifies the appropriate research methodology for various applications;
  - build on the experience gained in specific project implementations;
  - construct a database to make it possible to validate the choices made by experts by comparing them with service feedback;
  - publish an applications guide to guarantee an exhaustive level of assessment while protecting the railway community from unnecessary over-specification.
- **Final period**: after validation by the Member States, publication of these research conclusions, and the associated guidelines will lead to the general application of these methods by the entire railway community.

Other related areas of research envisaged include:

- a network of shared test facilities with common acceptance procedures for telematics and other safety critical systems;
- improved capability of monitoring and diagnostic methods for vehicles, signalling and infrastructure systems to maintain high levels of availability and productivity;
- improved vehicle and infrastructure design and maintenance techniques possibly based on practice used in the aerospace sector;
- new maintenance recording technologies;
- common monitoring and assessment methods and regimes to identify endemic technical failures to give feedback to design and product development processes.

4.2.4 Retaining the Environmental Advantages of Rail

Rail has strong environmental credentials in terms of energy efficiency, noise generation, and load carrying capacity and land use for operations when compared with other modes of transport. The industry has not in the past been able to translate these very powerful attributes into commercial advantages or competitive products and services. In addition, today, rail's inherent advantages in the environmental field are under attack from technical advances by other modes.

Rail generated **noise** is, by comparison with other modes, less intrusive but can still be further constrained by the adoption of new materials, manufacturing and operating methods and systems, and last but not least, land use planning. The transfer of freight from road to rail is being hampered by public reaction to the increased numbers of night trains. Unless harmonised cost effective solutions can be quickly implemented the whole strategic thrust could stall.

Increasing concern over **energy utilisation and conversion efficiency,** governed by international protocols and treaty obligations on emissions, suggests that rail can build on its inherent strengths by reducing energy consumption through the entire life of a product, component or system, including manufacturing methods.

The ability of the industry to **recycle** an even larger proportion of material inputs, including liquids and consumable parts, through innovative design, manufacture and servicing techniques could realise significant benefits as well as commercial advantages.

The ability of the rail network to accommodate more traffic through the adoption of new command, control and communications technology could bring about **wider environmental benefits by securing a modal shift** away from more energy and land dependent transport technologies such as road and air transport. This will need to be achieved without the sacrifice of any service and product standards and customer expectations.

In addition to strictly commercial objectives, increasing recognition of environmental issues will be made in EU policy. This will cover permitted emissions (gases, waste products, noise, etc…) and the ability of rail to exploit its inherent energy efficiency to commercial effect. Post Kyoto, EU policy may also drive the need to operate efficiently using energy derived from various fuel and other renewable inputs (a capability that the primary transport competition does not have) and to recycle a large proportion of the industry's primary material inputs. **Research and Technology Development priorities must be identified prior to the formulation of new European standards**, so that products that are cost effective as well as green can be encouraged.

The focus of environmental research and technical development should include:

- adapting noise attenuation techniques to differing Networks ahead of emerging standards;
- noise and vibration footprints in comparison with other modes;
- reduced emissions including electromagnetic emissions;
- recycling of materials used in the construction & refurbishment of rail vehicles and infrastructure;
- energy efficiency and alternative energy sources.

4.2.5. Innovative Materials

It is proposed that the rail sector participate in programmes initiated by other members of the land transport modes to access knowledge, expertise and experience in the use and application of new materials and technology**.**

Rail cannot ignore advances made in other industries in relation to new materials and their associated manufacturing techniques, in view of the advantages they endow in terms of cost, strength, weight reduction, fire resistance, lower maintenance costs and potential to recycle.

The use of innovative materials for significant infrastructure components, and for larger proportions of rail vehicles, offers significant potential in terms of lower whole life costs. The potential to **pool experience and expertise across from other industries and applications** in Europe may yield significant benefits to the rail industry.

4.2.6. Production Methods

Rail must reduce its cost base across the entire spread of activities undertaken within the industry. Interoperable standards will hopefully reduce the range of goods and services required and generate economies of scale. This trend will reinforce the need to lower whole life costs by adopting **lower cost manufacturing methods** already deployed in other industrial sectors for large and small batch manufacture.

The use across Europe of **common design codes** for vehicles, components and systems should reduce the cost and time of development and manufacture. Allied with the adoption of a **'virtual' certification process** using computer models of the finished product (as used in the aerospace sector) this type of initiative could lower the 'time to market' lead-time significantly. Both measures will enhance the prospect for the genuine international competitive supply of products and services.

5. DELIVERING A JOINT STRATEGY FOR EUROPEAN RAIL RESEARCH

5.1 The Change Mechanism

In the Memorandum of Understanding, signed by UIC, CER and UNIFE on the 30th of June 2000, the representatives of the Railways and the Rail Supply Industry committed themselves to set up a common research and development working-group. This group, the **European Rail Research Strategy Group,** provides guidance to identify common needs, encourage collaboration and determine priorities for research.

This linkage is needed to create a seamless transition between aspirations and live projects, and maximise the value of the work programmes and networks of excellence. The integration of relevant existing work programmes into the new initiative needs to be considered.

5.2 Members

Members of the Joint Strategy for European Rail Research, should include the following bodies (listed in no implied order of priority):

- UIC: International Union of Railways;
- CER: Community of European Railways;
- UITP: International Association of Public Transport;
- UNIFE: Union of European Railway Industries;
- AEIF: European Association for Railway Interoperability;
- The European Commission.

The involvement of rail operators or suppliers who elect to operate outside the umbrella of these existing railways and supply industry bodies should be encouraged. **National and pan-European institutions**, including the EC and national rail/transport authorities, should be included along with accredited standardisation bodies such as CEN (European Committee for Standardisation), CENELEC (European Committee for Electrotechnical Standardisation) and ETSI (European Telecommunications Standards Institute) where their involvement could prove fruitful.

Of paramount importance is the inclusion of national and international passenger and freight **user groups**, international logistics service providers, booking agencies and related systems suppliers, including providers of emergent e-commerce concepts.

The consortium of Railways and Supply Industry who elect to support the development of the Joint Strategy for European Rail Research **will be fully representative** to avoid concerns about the development of power blocks or the sidelining of SMEs and minority interests.

5.3 Project Management

The role of the European Rail Research Strategy Group is envisaged as follows:

- Maintain the railway research key projects under continuous review to ensure:
  - the relevance of the programme;
  - the order of its priorities;
  - the level of real impact on the railway's commercial and competitive position;
- Provide support to members of the rail industry planning, developing and submitting proposals to the EC;
- Provide relevance between research results and their application;
- Analyse the economic and technical consequences of applying the research results, typically within harmonisation bodies such as AEIF;
- Discuss and disseminate research results and future developments with the EC;
- Promote the Joint Strategy for European Rail Research agenda within the European Commission;
- Prepare reports for the needs of standardisation;
- Maintain rail technology and operational developments under review.

The Group will have formal and informal links to industry harmonisation and research bodies.

6. TOOLS FOR RESEARCH

6.1 Project assessment

Research projects will be vigorously assessed for **commercial potential** prior to their submission, so as to attract the support of the European Commission and the funding they deserve. This procedure will be linked to a process of market planning and product development and should provide the measure of return on investment that the EU evaluation guideline demands.

The use of indicators such as: Net real revenue enhancement; Passenger volume and sector distance travelled; Growth in originating cargo tonnage and tonne kilometres operated; Capacity utilisation (infrastructure and vehicles), in comparison with other modes, should form an integral part of any process identifying Research and Technical Development priorities and rankings.

6.2 Clusters

It is proposed to use clusters to **integrate and validate innovative solutions** in the transport system in relation to priority areas backed by EU legislation. These contain a mix of core commercial and wider issues but focus on interoperability (as the primary commercial requirement for passenger and freight users), safety and the environment. The role of the Strategy Group, as a guiding hand to identify common research needs, encourage collaboration and rank initiatives, is therefore vital if coherence between the wide range of individual tasks is to be maintained.

6.3 Networks of Excellence

Networks of Excellence can establish valuable links with other industries and academia and help to develop new systems and techniques, while reinforcing the prioritisation process. **Knowledge transfer** is fundamental to the support of an innovation-lead culture and could provide some solutions for large multi-partner cross border projects. Linking Networks of Excellence to national research and technical development programmes potentially lowers the loss of knowledge and fragmentation of effort as the industry liberalises and restructures.

For joint rail research to be truly effective it is essential that the subjects identified in this strategy be dealt with in a co-ordinated manner across the European Union. This will be best achieved if the resources of major rail research bodies such as those of SNCF and DB AG can be harnessed to test centres, such in Poland and the Czech Republic, and the laboratories of the private sector suppliers and academia. All coming together to create a single **European Rail Research Area**.

Networks of Excellence can also serve as a mechanism to **identify new research needs and to disseminate results of other industry's research**. It is vital that the Joint Strategy for European Rail Research is open to technology and systems from beyond the confines of the railway sector where it is appropriate, and helps to reinforce rail's inherent capabilities. The imminent enlargement of the EU will give an added dimension to this initiative.

CONCLUSIONS

This vision for the railway industry relies on achieving ambitious goals and a continuous search for technological and operational excellence.

The partners commit to make railways an attractive, affordable, safe, clean, competitive and reliable transport mode on a European scale.

We maintain that joint EU research aimed at guaranteeing indisputable technological and operational improvement is crucial.

We are convinced that joint research into the practical implementation of Rail Interoperability is key to achieving a complete Single European Railway System, and is decisive for the success and the competitiveness of the Railways and the Rail Supply Industry.

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