

**ERRAC**

The European Rail  
Research Advisory  
Council



# RAIL21

SUSTAINABLE RAIL SYSTEMS  
FOR A CONNECTED EUROPE

## ERRAC, the impetus for innovation in the European rail sector

The European Rail Research Advisory Council (ERRAC) was set up in 2001 with the ambitious goal of creating a single European body with both the competence and capability to help revitalise the European rail sector and make it more competitive, by fostering increased innovation and guiding research efforts at European level.

In December 2002, ERRAC unveiled its Strategic Rail Research Agenda (SRRRA) to the railway community. This European rail initiative paves the way for new innovative forms of collaboration, and has been one of the pioneers for the “technology platforms”, which may lead to major joint technology initiatives during the European Commission’s Seventh Framework Programme (2007-2013).

ERRAC is currently chaired by Åke Wennberg (Bombardier Transportation). The Vice-Chairmen are Philippe Renard (SNCF) and Prof. Manuel Pereira (Technical University of Lisbon). ERRAC comprises of 45 representatives from each of the major European rail research stakeholders: manufacturers, operators, infrastructure managers, the European Commission, EU Member States, academics and users’ groups. ERRAC covers all forms of rail transport: from conventional, high speed and freight applications to urban and regional services.

### ERRAC is focussing on:

- ① Defining and implementing a **joint European rail research strategy** for the next 20 years through:
  - the elaboration of the Strategic Rail Research Agenda;
  - sustained, high-level commitment from all stakeholders;
  - agreement on common positions and recommendations for various rail research issues.
- ② Enhancing **collaborative European rail research** by:
  - building consensus among stakeholders;
  - improving synergies between EU, national and private rail research ;
  - strengthening and re-organising research and development efforts;
  - facilitating effective pooling of human and material resources;
  - launching ambitious co-operative research schemes.

For further information:  
please visit the ERRAC website

[www.errac.org](http://www.errac.org)

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Dear Reader,

Europe's railways provide a vital transport infrastructure supporting Europe's citizens and businesses through increasingly fast, efficient and comfortable passenger travel as well as the timely shipment of freight around the continent. However, a large part of the European network is already working to its maximum capacity and customer expectations are increasing. New technologies are needed in order to meet these demands and further enhance the role that railways play in providing reliable, affordable, safe and environmentally friendly transport for long and short distances.

This brochure will help explain how targeted European, national and private research can meet the key economic and social challenges of the European Union. It sets five broad targets for collaborative surface transport research to be addressed within the "Seventh Framework Programme (2007 to 2013) of the European Community for research, technological development and demonstration activities" and presents them for consideration by the key decision makers at European and national level. The following gives an overview of the five targets:

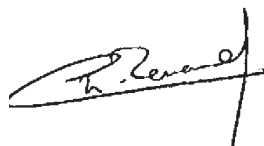
- 1 promote excellence in railway operations to encourage modal shift and decongest international transport corridors;*
- 2 develop attractive urban transport solutions that ensure sustainable urban mobility;*
- 3 consolidate environmental gains based on the greening of rail surface transport to meet legislative and societal imperatives;*
- 4 assure personal security to encourage increased use of public transport and*
- 5 strengthen the worldwide competitiveness of the European rail industry sector and its ability to supply cost effective products and services.*

The success stories presented in this brochure prove that investment in rail research will be repaid many times over as railways offer ever better, faster, safer services to passengers and freight forwarders leading to an improved environment, reduced congestion in cities and on motorways as well as greater choice for the traveller. The result will be greater economic prosperity and quality of life for all European citizens.

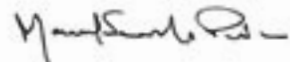
Yours truly,



Åke Wennberg  
Chairman



Philippe Renard  
Vice Chairmen



Manuel Pereira  
Vice Chairmen

## RESEARCH FOR A SUSTAINABLE FUTURE

The EU White Paper of 2001 “European transport policy for 2010: time to decide” sets ambitious aims for modal shift in European transport, with rail playing a major role in the future. ERRAC has produced Rail21 to identify possible solutions to the technical and organisational obstacles to the realisation of the White Paper objectives. Implementing Rail21 with the support of FP7 will further develop the railway system to counteract increased traffic congestion and its adverse effects on environmental and public health.

### The rail sector represents a genuine economic strength for Europe

The European railway and urban mass transit operators generate an annual turnover of around 90 billion Euro with a workforce estimated at 1,000,000 people. In addition, the European rail supply industry employs more than 130,000 people and generates an annual turnover of around 35 billion Euro. The European railways run the fastest passenger trains, have the largest high-speed network, are constructing the longest tunnel, offer numerous attractive and efficient metro and light rail systems and have implemented a unique integration of long distance high speed, regional, urban and freight networks on a continental scale. In short: the European railways possess a leading position in the world.

European manufacturers have 70% of the world rail market valued at 50 billion Euro in 2003 and European designed and built trains run on all continents. However, international competition in the rail supply sector is increasing, not only from Japan, but also China and Korea, whose industries are developing rapidly and are making inroads in world markets. Continuous technological innovation and ever increasing value for money are the only way to sustain Europe’s current leading position. Standardisation is a key issue in this, for it will allow for economies of scale, reduced time to market and reduced technical risks. Currently, European suppliers devote more than 500 million Euro to research each year and have invested in excess of 1 billion Euro in the new European signalling system ERTMS alone. This secures high value jobs and exports, and provides Europe with a world-class railway system.

### Success stories illustrate the role of research

Investments and political will to improve the economy and/or quality of life are essential to achieve improvements to the railway system. However, good research has proven to be essential for creating the conditions necessary for realising these improvements in a cost-effective way.



#### SUCCESS STORY: HIGH-SPEED SERVICES IN FRANCE

On September 22nd 1981, the first part of the high-speed line between Paris and Lyon was inaugurated. Technology, investments and international co-operation have enabled the TGV network to expand rapidly, with up to 700 trains currently running in eight different European countries. The TGV welcomed its billionth passenger in November 2003 and expansion will continue, with new trains and cities added each year.

Along the busiest line, a 300 km/h train with up to 1,000 people passes every 2,5 minutes. This operational excellence is combined with an attractive pricing strategy, which has led to an enormous popularity of the system and strong reductions in air traffic. For example: rail currently holds a 71% share in Europe’s largest rail/air market (London-Paris), whereas the air service between Brussels and Paris has disappeared altogether.

### SUCCESS STORY: TRAM-TRAIN IN KARLSRUHE

Since the early 20th century, the city of Karlsruhe has gradually developed its tram network, of which 80% is now running on a dedicated track. Karlsruhe was the first city in Europe to investigate the possibility of track sharing for light and heavy rail vehicles. The enormous success of the implementation of this idea has turned the city into a “model case” for similar developments worldwide.

In 1979, tram-trains were first allowed to use the “heavy rail” network on the line to Hochstetten. The success of this first link prompted further extensions of the network to other parts of the city, and to neighbouring cities. Currently, the urban and regional rail network around the city of 300,000 inhabitants comprises 14 lines, adding up to a total length of 750 km, and continues to expand.



To illustrate this important role of research, ERRAC has selected a number of success stories to be presented in this document. These success stories underline the ability of Europe’s rail research to meet the challenge of providing cost-effective and tailor-made solutions to improve the railway system.

Without a thorough understanding of vehicle-track interaction, it would not have been possible to run trains at 300 km/h in complete safety. In a similar way, many more examples of the direct relation between research and improved services for the end users can be given:

- more cost-effective construction and maintenance methods lead to the construction of more lines and affordable ticket prices,
- intensive research into timetabling and signalling enables higher frequencies and/or increased reliability.

### SUCCESS STORY: CUSTOM-MADE FREIGHT TRANSPORT BETWEEN SPAIN, GERMANY AND SLOVAKIA



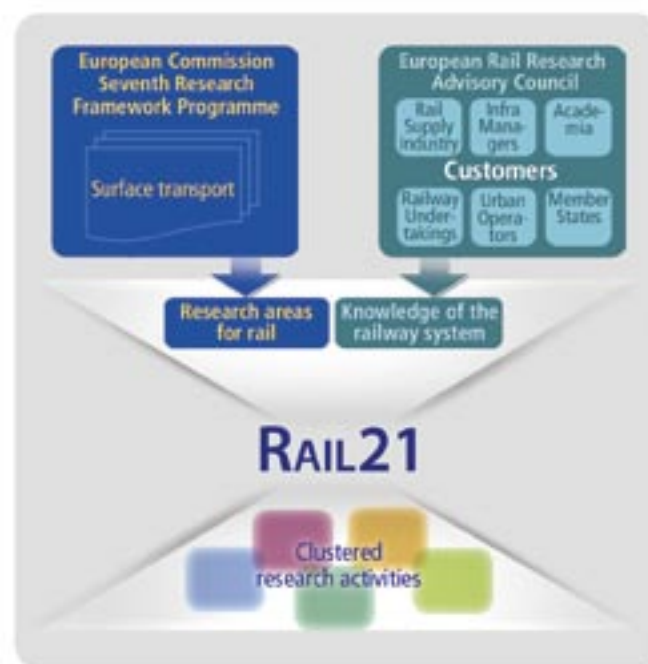
A new transport link is put in place for Volkswagen Transport GmbH & Co. OHG (VWT) to optimize logistic links between the VW plants in Pamplona (Spain) and Bratislava (Slovakia). The Pamplona plant presses parts for the VW Polo for its own use and for the Bratislava plant. Various other German plants supply the Pamplona plant with heavy goods such as engines and axles.

In order to optimise these shipments, a direct freight service was established, which now runs five days a week from Pamplona to Ingolstadt. From there, the Spanish pressed parts are forwarded to Bratislava, while the empty carriages are transferred to the German VW plants. The 2,200 km distance between Pamplona and Bratislava is covered within 72 hours, with each train carrying around 1,400 tonnes of material.

## THE RAIL21 APPROACH

In order to explore the best way forward for European rail research, the ERRAC Rail21 approach aims to maximise use of the technical, operational and commercial knowledge to deliver the research needs of rail through European collaboration. The overall approach is illustrated in the diagram shown below.

The Rail21 brochure describes five clusters of research activities that integrate the European Community's Seventh Framework Programme (FP7) and the ERRAC Strategic Rail Research Agenda (SRRRA).



The Rail21 Approach

### Seventh Framework Programme of the European Community (FP7)

The European Commission has defined a global EU Surface Transport research agenda in its Seventh Research Framework Programme for 2007-2013. In this proposal, rail is recognised as an important transport mode from which much is expected. Increased passenger and freight traffic by rail will lead to economic growth through reduced congestion on major roads and in cities, contributing to Kyoto targets by reducing CO<sub>2</sub> emissions and offering greater choice and flexibility to European citizens.

The five sub-activities of surface transport research in the framework programme are:

- the greening of surface transport;
- encouraging modal shift and decongesting transport corridors;
- ensuring sustainable urban mobility;
- improving safety and security and
- strengthening competitiveness.



## ERRAC Strategic Rail Research Agenda (SRRA)

The SRRA published by ERRAC in September 2002 represents the second major guideline for the Rail21 approach. It focuses on five strategic research priorities:

- *interoperability*: standardisation of Europe's railway systems to allow seamless movement between national networks;
- *intelligent mobility*: real time information to allow seamless movement between modes;
- *safety and security*: improving objective and perceived safety for passengers and staff;
- *environment*: strengthening rail's leading position concerning the greening of transport and
- *innovative materials and production methods*: improving competitiveness of suppliers, operators and infrastructure managers.

Together, these priorities aim at delivering far better customer experiences at lower cost.

## Integrating the SRRA and FP7

With the Rail21 approach, ERRAC has been able to integrate the requirements of FP7 with the research agenda set by the railway sector in its SRRA. It is shown below, how this has resulted in the definition of five research clusters.

Each of the research clusters identified covers the rail system as a whole. As a result, there are obviously a lot of cross-relations between the different clusters. For example: excellence in operations and increased personal security also contribute to attractive urban transport.



The five research clusters of Rail21

The ERRAC stakeholders have also identified 'value for money' as a transversal topic and starting point for all five clusters, because the biggest issue facing the European railways at the moment is driving down costs.

# MEETING THE CHALLENGE AHEAD – IMPLEMENTING RAIL21

## Value for Money

Increased cost-effectiveness will enable Europe's railways to invest in improvements and to foster competitiveness vis-à-vis other modes of transport, as well as keep on offering affordable services without having to put additional pressure on taxpayers. A number of main cost-effectiveness drivers should be considered for railway operations, infrastructure management and urban transport systems. Influencing these drivers is a key issue for the long-term financial sustainability of the railways.

The best way to reduce the costs of **railway operations** is to:

1. **Increase the speed/productivity of all assets**, so that the same amount of freight can be shipped against lower costs (a train that circulates faster needs less rolling stock and staff capacity and occupies tracks and platforms shorter; this is equally valid for passenger transport). A positive side effect is that a faster railway is more attractive to its customers.
2. **Increase the capacity**, so that more freight can be shipped and/or more people can travel against the same costs. A positive side effect is that increased capacity can also enable a more robust operation, making the railway more reliable.

The best way to reduce costs of **railway infrastructure** is to:

3. **Simplify the infrastructure**, so that the same functionality can be provided with less equipment (less turnouts, less level crossings, etc.). A positive side effect is that a less complex railway will be safer and more reliable.
4. **Make better use of the existing infrastructure**, so that there will be less need for installing more equipment or additional tracks/platforms. A positive side effect is that this will enable railway operators to provide a more frequent and/or more reliable service to its customers, without increasing the costs.

The best way to reduce costs of **metro networks**, and to a lesser extent for light rail, is to:

5. **Serve more customers with less staff**, e.g. by working towards unattended operation, higher frequencies, multi-skilled staff and improved real time information.
6. **Achieve economies of scale**, e.g. through harmonised acceptance criteria and mutual recognition of sub-systems to reduce lengthy and costly administrative processes, or by increasing interchangeability of hardware and software through common interfaces and technical prescriptions.

Cost-effectiveness should always relate to the railway as a system. For the six points mentioned above, the total cost reduction will largely compensate the total cost increase, but the costs and the benefits may be generated in a different company. For instance, unattended operation reduces the operation costs, but may increase infrastructure costs. This creates a large barrier for cost-effectiveness, which should be addressed and removed.

The following pages give a short description of each of the five rail clusters – Excellence in Operations, Attractive Urban Transport, Environmental Gains, Personal Security and Worldwide Competitiveness.

## EXCELLENCE IN OPERATIONS



An important research goal is to release all the potential in the existing rail systems in order to create and accommodate modal shift in the most cost-effective way.

This overall goal is addressed by exploring improvements in operations and timetabling, on international freight and passenger corridors, in regional and urban rail.

Reliability, accessibility, speed and capacity are therefore the key words in this cluster.

The three themes defined below, focus on a continuous increase in speed and capacity of the railways. This will facilitate a modal shift and the decongesting of European transport corridors to take place and it will contribute in the most cost-effective way to a safer and greener surface transport in Europe.

### Operations21

*'At the world's busiest railway station, most trains have a dwell time of less than a minute'*

Experts in railway operations agree that there is still a large potential for production improvement in the field of timetabling, planning and operations management. The biggest gains are expected from innovative ways of increasing timetabled speed, capacity and connectivity of the railways. Operational design lies at the heart of the reliability of the system.

#### Illustrative research topics

- Find innovative ways to accommodate traffic growth with existing assets
- Increase timetabled speed through higher reliability and less margins
- Work towards operational free-flow and clock-faced timetables
- Centralise access to data on rail assets and content of freight trains

Abfahrt / Départ / Partenza	Destination	Time
10:49	Frankfurt	6
10:54	Liestal, Basel, Olten	8
11:06	Olten, Bern, Thun, Spiez	14
11:21	Olten	4
11:34	Wetzlar, Frankfurt, Hannover	8
11:54	Olten, Luzern, Lugano, Chiasso	12
11:58	Laufen, Delémont, Biel	12
11:57	Laufen	10
11:57	Köln, Dortmund	10
11:58	Laufen	10
11:54	Pharmahallen, Brugg, Baden	3
11:57	Mülhausen	33

#### SUCCESS STORY: PASSENGER TRANSPORT IN SWITZERLAND

Between 1985 and 2003, the amount of railway passenger-kilometres in Switzerland increased by 55%, while the growth of the individual road traffic over the same period was only 25%.

A combination of investments for rail, increased operational excellence (e.g. the regular timetable) and a good marketing strategy (e.g. the half-price card), has resulted in shorter door-to-door travel times, more trains and lower prices.

But the success does not end here. The recipe of combining smart investments with operational excellence and good marketing was again adopted for the new 'Bahn 2000' timetable, bringing more and considerably faster trains. This yielded a 7% growth during 2005, with further significant growth foreseen for the near future, following the opening of new transalpine tunnels and the installation of ERTMS signalling.

## Corridor21

*'3,000 people per hour on a highway lane create congestion. On a railway track, over 10,000 are assured of a smooth ride.'*

Research is needed to analyse passenger and freight flows and how to shift these transport and logistics chains towards European rail corridors. Specific points of attention are the telematics applications for freight (and passengers), innovative implementation of cross-border interoperability as well as the speed of the transport chain as a whole (including the quality of integration between different systems and modes). Also, the migration of the new European signalling standard (ERTMS/ETCS) into the railway system requires a solid basis of collaborative research.

### Illustrative research topics

- Elaborate the most cost-effective solutions/ standards to implement specifications for interoperability
- Work on Europe-wide corridor path allocation and logistics chains
- Analyse and optimise traffic flows
- Identify (socio-)economic and administrative modal shift drivers
- Implement "corridor action plans"

## RegionalRail21

*'The highest growth figures in European transport are realised in regional rail'*

Benchmarking within Europe is the key word for this activity; there are many impressive success stories to be told about abandoned or under utilised infrastructure being converted into modern, high-quality regional rail services. Further progress is possible here. It is therefore important to develop a harmonised European approach for cost-effective improvement of regional rail, addressing and removing the barriers for implementation and raising the awareness about the possibilities and their value for society.

### Illustrative research topics

- Benchmark global transport systems and analyse barriers for implementation
- Analyse the possibilities for "a train with multiple lives", running on different franchises and networks
- Assess the potential for regional high speed
- Define cost drivers and public (non-user) values for regional lines

### SUCCESS STORY: INTEGRATED REGIONAL TRANSPORT IN EAST-NETHERLANDS

During the 90's, an integration and decentralisation scheme to improve the quality of public transport in the rural eastern region of the Netherlands was implemented. This started with tariff integration and better connections and ultimately resulted in the establishment of a single franchise contract for all transport in that region.

The new operator started in 1999 with the "fishbone model", in which the railway serves as backbone and parallel bus lines are replaced by new bus lines feeding to the railway. Connections are guaranteed (trains and buses wait for each other). Moreover, frequencies were doubled and new light trains and buses were introduced. In just over five years, this has led to a doubling in passenger numbers. Recently, the system has expanded through tendering and now covers four rail and more than thirty bus lines.



## ATTRACTIVE URBAN TRANSPORT



The damage done by road transport to historical city centres, to the living space and, not in the least, to people's health remains a seriously underestimated problem.

In some cities in the world, over 60% of the surface is used for road transport. For most European cities, this is around 20%. In these cities, fast, efficient and environmentally conscious public transport should be provided, using far less space than the road. For European cities to continue to grow and to offer a high quality of life to their citizens, attractive urban transport is vital.

Even though most of the important measures in the field of urban mobility (congestion charging, pedestrian zones, light-rail schemes, etc.) have a highly political nature, research will enable decision makers to better understand their impact on urban mobility and to provide guidelines to ensure sustainable urban mobility. The following three themes show that considerable experience with best practices and a good understanding of the developments in urban mobility will lead to cost effective solutions for each requirement.

### CityRail21

*'The segregation of modern urban transit from road traffic is a guarantee for success'*

The many opportunities for the adaptation of existing heavy rail lines for urban rail are not yet fully explored. Also the dedication of street lanes to light rail, or the creation of new infrastructure, for example for metro, is a highly cost-effective contribution to the quality of life in most cities. Barriers to the implementation of these and other measures for improved urban rail transport must be addressed and removed.

#### Illustrative research topics

- Look into the adaptation heavy rail urban infrastructure for light rail (incl. compatibility of rolling stock)
- Harmonise urban/regional rail installations (incl. concepts of tram-train design)
- Compare the available capacity to the required capacity for passenger traffic (incl. closed or unused lines)



### SUCCESS STORY: THE METRO SYSTEM IN MADRID

The Madrid metro had a length of around 100 km, when its ownership was taken over by the City of Madrid and the Community Council after a decentralisation process. An ambitious plan of expansion started in 1995. Within ten years, a clear and low-cost design philosophy and modern building techniques enabled the Madrid metro company to extend the system up to 227 km and 190 stations.

The attractiveness of the new system (e.g. it takes just 15 minutes by metro from the airport to the business centre of Madrid) pays off: the trains carried no less than 615 million passengers in 2004. The urban rail expansion program is still underway, including more extensions as well as 40 km of light metro lines. In parallel, new rolling stock has brought a significant improvement in terms of technology, comfort and safety.

## Transfer21

*'Seamless passenger transport'*

Better co-ordination between complementary modes needs to be achieved. This activity addresses the integration of the door-to-door transport chain as a whole, as well as the Technical Specifications on Telematics Applications for Passengers. The key words are: connectivity, intermodality, information and ticketing. Research should find optimised and innovative solutions to channel passenger flows in the fastest and most comfortable way. Improvements to passenger transfer facilities should also be addressed:

- Which design is the most attractive?
- How to measure the quality of a transfer facility?
- What is the impact on the modal split?
- Which commercial facilities are most appreciated?

### Illustrative research topics

- Execute town and transportation planning case studies
- Develop new concepts for urban rail design (services, infrastructure and rolling stock)
- Passenger telematics
- Find innovative solutions for sustainable funding of investment in rail systems or services

## Citizen21

*'Attractive transport systems for attractive cities'*

Cities everywhere in Europe have a massive potential for cost-effective urban rail solutions. The necessary data, socio-economic factors analytical methods for assessing the impact of urban transport policies and innovative services on, for example, the turnover of city-centre shops, need to be explored. A specific issue is the urgent need of maintenance and modernisation of extensive tramway systems in central and eastern European countries, which can, given the current limits to funding, only be achieved with the provision of cost-effective rolling stock and segregation from road traffic.

### Illustrative research topics

- Develop common door-to-door electronic ticketing, integrate with other electronic payment services
- Analyse passenger flows: connectivity, intermodality and information systems
- Improve the design of transfer facilities, including logistical flows through commercial facilities



### SUCCESS STORY: LIGHT RAIL IN NANTES

During the 50's, tramways almost entirely disappeared from the French urban landscape. Nantes was the first French city to reintroduce a modern light rail system in early 1985, with a first line of 6 km. The system was extended over the years to a network of three lines and 36 km, carrying 200,000 passengers a day, which is in addition to the 160,000 passengers using the complementary bus system.

The urban development profited strongly from a renovation of the urban fabric all along the lines, as it has been the general case for the numerous Light Rail systems that developed afterwards throughout the country. The results are remarkable: quieter, safer and less polluted town centres have become significantly more attractive to both citizens and visitors, thus giving a boost to the local economy.

## ENVIRONMENTAL GAINS



Railway transport is (and will remain) by far the most environmentally friendly form of motorised transport.

Nevertheless, the railway does not rest on its green laurels but continuously strives to improve in order to meet the growing expectations of society and become an ever better, quieter and cleaner neighbour.

On the other hand, the most effective contribution to the greening of transport in Europe is to encourage a modal shift to rail. It is therefore important to acknowledge that environmental measures are not to jeopardize the overall competitiveness of the railways.

### EcoRail21

*'Greening and cleaning the railways'*

It is important to keep and improve the leading environmental position for railway infrastructure and rolling stock, particularly, where legislative requirements are concerned in the fields of noise and energy efficiency.

Moreover, as one of the biggest land owners in Europe, railways have to continue to be a good neighbour to all and continue to be guardians of the environment. As a good neighbour, railways must:

- develop sustainable construction methods;
- look into ways of more efficient land use;
- maintain European architectural heritage and
- keep large land holdings in a way that enhances public enjoyment of them.

The keywords will be: "cleaning" and "greening" the means of railway production, for example by reducing the noise production or the weight of the trains.

#### Illustrative research topics

- Help improve and deliver achievable standards for noise, emissions, diesel engines, etc.
- Develop new lightweight and low noise freight wagons; greening existing fleet
- Look after existing assets: slimming down the infrastructure for more efficient land use (e.g. removing unused sidings, reducing the number of level crossings)



#### SUCCESS STORY: "WHISPER BRAKE" MAKES FREIGHT WAGONS QUIETER

One of the major problems of generally environmentally friendly rail transport is loud freight traffic during the night. Composite brake blocks are able to reduce the noise level during passing by 9 dB(A), because this so-called whisper brake prevents the wheels from roughening. Smooth wheel treads on smooth rail surfaces are the most important solution for noise reduction at source with respect to freight wagons.

Within the scope of a joint RTD-project the railways of the European Union and the supply industry have been able to prove the effectiveness, reliability and cost-effectiveness of this new brake block. In October 2003, the composite brake block successfully passed the process for unlimited homologation. With this technology, it is possible to comply with the demanding noise limits laid down in the Technical Specification for Interoperability on Noise.



## PERSONAL SECURITY

The perceived level of security plays an important role in the image of the railways and in the competitiveness of the railways versus other modes.

Despite the fact that rail is operationally an exceptionally safe form of travel, problems concerning personal security may be one of the biggest threats to the role of the railways in Europe; it is essential that research effort will be focused towards this subject.

### Secure21

*'A high level of personal security is one of the greatest assets of any transport system'*

Currently, a lot of measures for increased perceived personal security are developed and implemented in European railway systems (CCTV, ticket barriers, additional staff on stations and trains). In other parts of the world (mainly the United States) various other measures have been developed and implemented, which could be of use for European railways. Improving awareness and analysing lessons learnt are keys to increasing staff and public security. Convenient new technologies as well as practical innovative and cost-effective measures including new forms of inter-agency co-ordination could be adopted in order to improve emergency preparedness and quick regular service recovery.

However, the investments necessary for most of these measures are quite considerable. The cost-effectiveness analysis of possible measures should also cover their consequences for the competitiveness of the railways.

These measures and their potential effects can be integrated in a toolbox for better-perceived personal security. Within this toolbox, a specific research action is the (re-)design of infrastructure, stations and rolling stock. Increased visibility of staff, for example, is a very important development in this field, where already several benchmarks inside and outside of Europe are available.

When talking about personal security, it is important to distinguish objective and subjective security. Objective personal security can be measured in number and gravity of incidents. Subjective (or perceived) personal security is the security as it is experienced by each of the customers. There will be a certain impact of the objective security on the subjective security, but this impact is unknown and will vary strongly depending on time and place. In research on personal security the focus should obviously be on perceived personal security. This would help not only attract new customers to railways but also, in case of a dramatic incident, avoid a modal shift from public transport to less safe private transport modes.

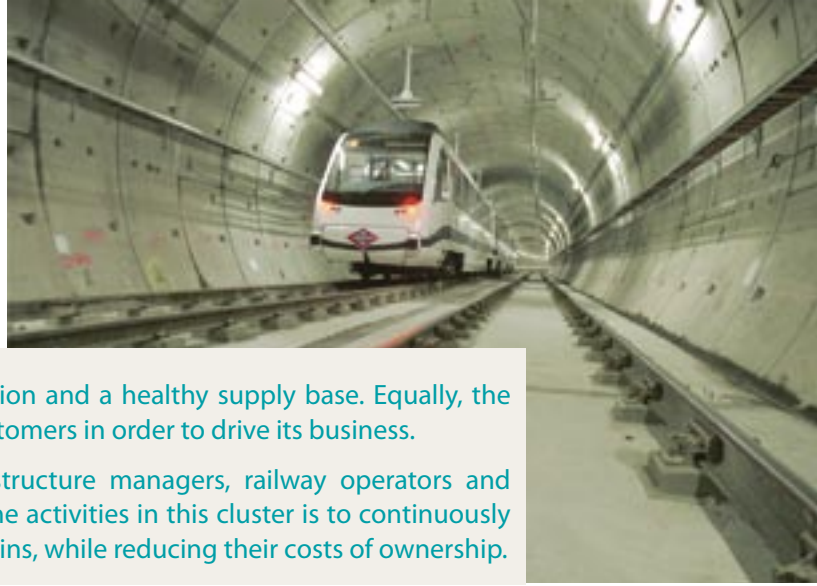
Unobtrusive new technologies hold out the promise of providing welcoming passenger environments on metro and mainline stations without introducing feelings of insecurity sometimes posed by public spaces. Barriers against the use of public transport could disappear altogether as customised applications of nanotechnology, innovative technologies and advanced communications, take advantage of passengers' mobile phones, satellite based location and contact-less cards, to better serve the passenger and take care of him all along his transport chain. Subtle monitoring and instant communications with security and train staff will maximise passenger safety.

#### Illustrative research topics

- Better integrate of personal security concerns in (re-)design of infrastructure, stations and rolling stock
- Assess the impact of personal security on 'Value of Time' and on modal split
- Provide a toolbox of measures for better personal security of public transport staff and customers
- Work on effective emergency and crisis management
- Develop initiatives for public transport security legislation, standardisation and certification



## WORLDWIDE COMPETITIVENESS



A railway cannot survive without innovation and a healthy supply base. Equally, the supplier base needs viable, innovative customers in order to drive its business.

Improving the competitiveness of infrastructure managers, railway operators and suppliers is a priority for all. The goal of the activities in this cluster is to continuously increase the performance of tracks and trains, while reducing their costs of ownership.

### LiteTrain21 & Infra21

*'Track-friendly trains on train-friendly tracks'*

These activities aim at a higher productivity of existing rolling stock and infrastructure, as well as development of new low-cost and high-performance trains and tracks for passenger, freight and urban transport. Intelligent rail systems can improve the competitiveness of the sector especially thanks to a reduction in the maintenance costs of vehicles and infrastructure.

#### Illustrative research topics

- Develop new, high-performance and low-cost ("maintenance free") urban and heavy rail infrastructure
- Develop innovative systems and constituents for increased performance (e.g. automation)
- Use predictive and/or preventive maintenance to increase availability and reduce costs.
- Develop a lightweight, safe, interoperable, higher speed, high-capacity European Intercity train
- Develop innovative high-capacity urban rail vehicles
- Work towards a faster fleet turnover (continuous improvement)

### SUCCESS STORY: MULTI-SYSTEM LOCOMOTIVES ON THE BRENNER ROUTE



Today, most national railway networks have their own power supply and signalling system. As a result, international freight trains need a change of locomotives at almost every border. The shunting and brake tests necessary for this change are an important barrier for increasing the average speed of freight trains in Europe.

However, the year 2005 saw the acceptance of modern, multi-system locomotives by Germany, Austria and Italy. The transit time from Munich to Verona via the Brenner route has thus been shortened by at least half an hour. The production of more locomotives, equipped with traction systems, pantographs and signalling systems of 15 European countries, is foreseen in order to enable more borderless traffic. Operations have already started on routes via the Gotthard and Tarvisio.

## Rail-Inno21

*'Enabling the implementation of research, now and in the future'*

In order to accelerate the implementation of successful research projects, it is indispensable to consider migration aspects from the start. The speed to market is an important issue in this matter, together with subjects such as a European driving license or a European Rail Business School, to assure a sound knowledge and skill base for now and for the future. Special attention should also be paid to the harmonisation of tender specifications and certification processes. The technical harmonisation of sub-system interfaces and basic parameters (for urban and heavy rail) are essential to the competitiveness of the European rail manufacturing sector and further research is needed to build consensus.

### Illustrative research topics

- European Rail Business School (knowledge / skill base)
- Speed to market; (virtual) test centre for certification of components/modules
- Driver training on simulators for "European driving license"

## TARGETS FOR THE FUTURE

This Rail21 brochure has been a common approach of the railway sector as a whole; each member of ERRAC has committed itself to this approach as well as to its own important role in the success of rail research. It has aimed to integrate the research areas for rail as set in the European Community's Seventh Framework Programme with the Strategic Rail Research Agenda of ERRAC. This has resulted in the definition of the five priority rail research clusters

Cost-effectiveness has been identified as the crucial transversal concern of all railway stakeholders as it will enable operators and infrastructure managers to become increasingly viable and innovative customers that, in turn, will drive the business of the supply industry.

Five targets for the future are derived from the five Rail21 research clusters that are worked out in this brochure by addressing concrete suggestions for research topics to be considered for collaborative research within FP7:

1. *promote excellence in railway operations to encourage modal shift and decongest international transport corridors;*
2. *develop attractive urban transport solutions that ensure sustainable urban mobility;*
3. *consolidate environmental gains based on the greening of rail surface transport to meet legislative and societal imperatives;*
4. *assure personal security to encourage increased use of public transport and finally*
5. *strengthen the worldwide competitiveness of the rail industry sector and its ability to supply cost effective products and services.*

Targeted research and its implementation enhance the competitiveness of train operating companies, infrastructure managers and manufacturers. The support of rail research activities by the European Union both in financial and political terms is a sound investment in a sustainable European transport system.



