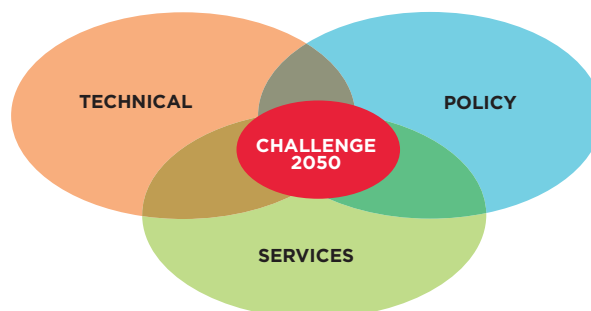




**RAIL TECHNICAL
STRATEGY** EUROPE

FOREWORD

Rail is a vital service to European society and the transport backbone of a strong economy. It has an unprecedented opportunity to achieve the sustainability it requires for the twenty first century. By doing so, it will be able to respond to the expected growth in transport demand, both passenger and freight.



In order to describe the associated challenges, in 2013 the railway community developed the business-led document “*Challenge 2050*”. This was developed on the three pillars shown in the diagram above and based upon the influences of key sector stakeholders, passengers, shippers, our neighbours, suppliers and rail operators. The vision highlights what Europe’s interoperable railway should look like in 2050. The sector made a commitment in Challenge 2050 to address how that vision should be attained and this Rail Technical Strategy is the next phase in that process.

To start the process of addressing the contents of the vision, the Railway Operating Community (ROC)¹ has prepared this Rail Technical Strategy Europe (RTSE) structured around the core themes set out in Challenge 2050 and which develops its technical pillar. This will enable the sector to exploit its opportunities to satisfy customer requirements and develop the rail system of the future accordingly.

The Technical Pillar expanded

The European rail sector must increasingly rely on its ability to exploit a stream of innovation so as to improve delivery of smart solutions across all our key outcomes: accessibility, capacity, safety, consistency, security, connectivity, value for money, sustainability (environmental, social and economic) and performance. This will help the sector to prepare for the challenges of how the future system is designed, constructed, operated and maintained.



1. The railway operating community (ROC) is the generic term used to describe those European RUs and IMs that are members of the CER or EIM and UIC.

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EXECUTIVE SUMMARY

To attract more passenger and freight customers and consistently satisfy their requirements, more innovative and cost-effective ways need to be found to increase capacity, improve performance at a system level and remove barriers to railway interoperability.

The strategy set out here is designed to support the transformation of the system and to shape the future railway in Europe. This RTSE comprises the following central elements of the railway system:

- Control Command and Communication (CCC)
- Infrastructure
- Rolling Stock
- Energy Supply and Consumption
- Information Management
- Railway People
- Security
- Safety

A successful future railway system needs all its assets to be of high quality and in particular the service to the customer has to be adapted to contemporary quality expectations. The level of the quality of these services will be ensured through the development and publishing of excellent standards by the sector. Maintaining and improving these standards in accordance with business needs, customer expectations and the provision of a positive travel experience, will demonstrate the emerging maturity of the railway operating community (ROC)² in collaboratively managing the rail system.

Rail is first and foremost a system. It must be designed, constructed, operated and maintained holistically but also take account of the importance of the interfaces between its constituent parts, some of which are safety critical and upon which the integrity of the system depends. No part of the rail system should therefore be developed without due consideration of the effect on other parts of the system.

This system approach requires coordinated planning and operation of the system, with collaborative and aligned asset management. The adoption of a sector-wide framework, as described in this RTSE, supports the implementation of change and subsequent improvement to reliability, availability, maintainability and safety (RAMS). This will be a significant step towards a cohesive rail system.

2. The railway operating community (ROC) is the generic term used to describe those European RUs and IMs that are members of the CER or EIM and UIC.

➤ THE SYSTEM AND ITS OPERATION



06.

**CONTROL, COMMAND
AND COMMUNICATION (CCC)**



08.

INFRASTRUCTURE



10.

ROLLING STOCK



11.

ENERGY SUPPLY AND CONSUMPTION



13.

RAILWAY PEOPLE



14.

INFORMATION MANAGEMENT



15.

SECURITY



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SAFETY

THE SYSTEM AND ITS OPERATION

SYSTEM OVERVIEW

VISION

The European rail sector is proud to be the global leader for rail transport because it adapts readily to technological and commercial opportunities, many of which span state and operational boundaries.

The rail system is designed and operated through a holistic system-focussed approach. Complexity is managed by means of standardisation leading to improved interoperability. Resilience and efficiency have been increased by fostering the interaction of system components, the adoption of modular construction principles and the support of automation.

Based on detailed performance analysis, the system has developed high quality operational standards. Targeted removal of bottlenecks (both physical and procedural), maximises system capacity and minimise the cost of system operation and maintenance.

Improvements to the simplicity, transparency and quality of the freight products and services offered (seamless transport) attract customers to consider rail as their first choice mode for the transport of goods.

The system has been developed to accommodate demographic change and to support the important social focus on personal well-being and adapts itself to changing trends in consumer behaviour.

The sector works very closely with its neighbours to limit any perceived nuisance factors such as noise and vibration and so that they recognise the added value that rail brings to society and to the European economy.

OBJECTIVES

Fostering and developing enhancements to the interoperability of services across state and operating borders as set out in the Technical Specifications for Interoperability (TSIs) will continue to be a fundamental component of the future rail system as the transport backbone of Europe.

Crucial to a successful rail system is the development of a set of harmonised operating processes in the form of International Rail Standards (IRS). This level of system convergence is for the benefit of deriving harmonised technical requirements for rail technology. This is needed for reliable interworking and will foster the development of compatible components to facilitate cross-utilisation throughout the system and to reduce the cost of production and maintenance.

Essential to the growth of transport services is the reduction of overall life cycle exploitation costs of all rail sub-systems, minimisation of the effects of obsolescence and the effective migration of emerging technological innovation.

Rail will ensure that as a service provider in premium transport segments, it is equipped at a system level with the newest information and communication technology. This should be undertaken on the basis of user-friendly, fully accessible, useful and coherent registers that will facilitate seamless transition between transport modes for passengers and ensure the provision of a modern multimodal freight distribution system.

Cost drivers must be transparent and technology and standards adapted to local operating conditions without compromising the safety of the rail network. Investment in new, more resource-efficient technologies has and will continue to reduce the sector's costs.

These modern technologies will reduce the start-up timescales and costs for new services and products and accelerate and facilitate processes. The railway system will operate cost-beneficial passenger and freight services on a "forever open" basis that is accessible and highly available. Noise and vibration will be managed to socially and economically acceptable levels³.

The optimisation of the management of rail traffic (putting the "M" into ERTMS)⁴ is essential to minimising the cost of the railway system and to improving capacity.

High reliability of system components will lead to a highly reliable system which is a prerequisite for the development of track capacity. Targeted expansion projects will encourage capacity growth and meet the sector's own high punctuality requirements.

Service frequencies and train capacity will be such that passengers get the type of seat they want and shippers the type of service they need at times that suit them.

Improved system utilisation, yield management and organisational arrangements will maximise capacity on busy corridors.

The system will be highly automated both operationally and for monitoring vehicle and infrastructure condition and maintenance. On the rare occasions

when disruption occurs, services are automatically and dynamically reconfigured and customers advised. Business continuity is optimised by real-time traffic management, maximising capacity, conserving energy and minimising inconvenience to the passenger and the freight user.

Stations and terminals of the future will be designed around the need to blend in sympathetically with their surroundings but also to be able to match capacity, accessibility requirements and security aspects and support connectivity with other modes and feeding the 'last mile'.

Rail will only be successful if it is understood and managed as a whole system, with particular attention to the interfaces between its sub-systems that are developed from a whole system approach.

3. For further information please refer to the strategic document "Moving Towards Sustainable Mobility" – <http://www.uic.org/spip.php?rubrique1638>

4. ERTMS, the European Traffic Management System - standardised across Europe to aid interoperability.

CONTROL, COMMAND AND COMMUNICATION (CCC)⁵



VISION

The network is engineered for resilience and optimised by interoperable real-time traffic management that allows for intelligent, predictive and adaptable operational control of train movements, maximises system capacity and conserves energy.

OBJECTIVES

CCC development will go beyond being only a contributor for the safe separation of trains and become a flexible, real-time intelligent traffic management system. Enabling this to happen is a key aspect of future innovation within the rail sector.

In this sub-system as in others, rail will investigate the use of technologies developed in other sectors to identify where they can be adapted for railway use. This will allow access to more widely available components and lead to reduced costs.

The concept where trains can be run at very close headways, such as moving block and through the concept of convoying, is already understood. However, this has only a limited application to date; making this happen for rail and developing it to an even more innovative practice would enable optimal capacity and rail system utilisation.

ENABLERS

- The use of satellite-based services such as train positioning will be vital in tomorrow's rail system
- Standard CCC components in both hardware and software with appropriate safety mechanisms - which can be items that are already accepted and proven in other sectors (e.g. aviation) - as part of the global convergence of systems

5. Control, Command and Communication (CCC) as described here includes and then goes beyond the usual nomenclature of Control, Command and Signalling as it also includes Communications aspects that are vital to efficient system operation. It is a core technological sub-system that supports the design and operation of the rail system. Efficient CCC is crucial to a consistent approach to system connectivity and a major contributor to maximising system capacity.

THE SYSTEM AND ITS OPERATION

- Improved interfaces for the CCC sub-system:
 - Rolling stock - On-board equipment that receive the messages from the CCC system will have standardised modular structure with most components easily exchangeable and interchangeable
 - Infrastructure - This requires clear and comprehensive system architecture for future command and control systems
- Implementation of a systems engineering approach to systematically develop standardised systems
- Wireless data transfer as confirmation of train completeness
- Use of formal methods for supporting the development of the specifications for future generations of train control equipment and other sub-systems
- The “internet of things” - a smart network of inter-communicating assets
- Remote obstacle detection
- Standardised approach to remote diagnostics maximising performance and reducing maintenance and operational costs

INFRASTRUCTURE

VISION

The rail system supports vital pan-European rail corridors and co-modal links with other continents - a practical demonstration of the technological and operational innovations that have made it a global leader.

Interoperability ensures trains cross state and operational borders without delay or operational constraint, offering a smart and competitive alternative to short and medium-distance flights and water and road-borne freight flows.

Building on expertise from within the rail sector and from other modes, network infrastructure availability is developed to a high level and is resilient. This is measured by performance regimes for passenger and freight traffic.

Bringing together innovative technologies and concepts, the design, construction, operation and maintenance of network infrastructure is reliable, supportive of customer needs, cost-effective, sustainable, adaptable to future requirements, automated and resilient to hazards.

Stations and terminals are designed to meet the needs of the future customer and are the cornerstone for the provision of quality, accessible and reliable rail services and sector competitiveness.

OBJECTIVES

Rail system infrastructure must be designed to be intelligent (i.e. develop from being a passive to an active railway) and safe. It should adopt relevant infrastructure technologies from other sectors. Intelligent infrastructure will be fatigue and wear resistant and energy efficient; system components will be monitored autonomously in real time. The use of new operational and track engineering techniques across the network will reduce the need for intrusive maintenance and greatly improve the train/infrastructure interaction at conventional and high speeds such as the wheel/rail interface.

Understanding and management of rail contact fatigue, including the investigation of the influence of traction unit slip control, rail re-profiling, rail lubrication and friction modifiers will facilitate a system that is designed to optimise maintenance intervals and be cost-beneficial.

A focus on intelligence provided by the system (remote condition monitoring), will enable the establishment of what, when and where maintenance is needed. This will ensure that there is low impact through system interruption and maximisation of product availability to the customer.

Asset management tools will be developed that allow comparison of maintenance and/or replacement strategies for track and infrastructure based on traffic levels and whole life evaluation.



The future freight terminal must be designed for swift throughput and loading and unloading of trains.

The freight customer must have easy access to terminals. Optimising processes for train preparation will reduce the noise and vibration and so social nuisance from terminal operations and increase efficiency.

The railway should be operated on a “forever open” basis. Passenger stations should be adapted to new information needs. Ensuring that rail has “always informed passengers” will be facilitated by new IT capabilities, removal of barriers (between modes, between stations and the city) and maximising the role of stations in the city and in the transport system.

ENABLERS

Track and Structures

- Future slab track systems
- Cross-modal transport infrastructure management systems
- Optimisation of maintenance planning and scheduling
- New developments and concepts for switches and crossings
- Security of infrastructure materials and components
- Innovative ballasted and non-ballasted track-form designs

- Overcoming infrastructure limitation to heavy and long trains
- Non-intrusive infrastructure monitoring
- Modular “plug-and-play” design of infrastructure
- Optimised noise and vibration control
- Use of wireless progressive telecommunications to enhance operation, maintenance, passenger support and make possible intelligent trains and intelligent stations
- Development of technologies for facilitating the operation of services between systems with gauge differences – speeding up the changeover process

Station and Terminals

- New design concepts including universal accessibility and ageing society needs: Functionality, space management, information, way-finding, lighting systems, connections to other modes, people-friendly, train/platform interface
- Station management in the new passenger-centred horizon: balancing passenger satisfaction, commercial interest, rail operation and retaining the heritage
- Development of more efficient and privacy-friendly technologies and processes for station security

THE SYSTEM AND ITS OPERATION

ROLLING STOCK

VISION

Mass and energy-efficient, low whole-life cost rolling stock meets the evolving needs of its customers.

Rolling stock is designed in line with the needs of the future customer and will be critical for the provision of quality, accessible and reliable rail services and for the competitiveness of the sector.

OBJECTIVES

There are many things that attract the customer to use rail but it is the trains themselves that are the focal point of the customer experience. Train interiors that are comfortable, pleasant and adaptable to the needs of different groups of users such as families, business travellers or people with reduced mobility, will encourage these customers to use rail over and over again.

For the operators too, to meet customer requirements and for their own business success, reliability, safety and maintainability are vital.

Trains should be sensitively designed to be staff and customer-friendly. This should involve the operator as a client in the early stages of development

so as to ensure design specification quality that is based on common rail sector standards for quality assurance. They will be built using a modular approach with components that can be easily interchanged on a 'plug and play' basis to maximise flexibility and reliability and minimise maintenance downtime.

Modular vehicle design will allow easy upgrades during a vehicle's service life. This would respond to changing customer perceptions and requirements, business needs and usage and obsolescence mitigation - and thus be more sustainable.

Trains need to be intelligent so that they are constantly self-monitoring (automated condition monitoring), to establish what, when and where maintenance is needed.

Performance of the system and the interface between the train and track and between the train and control, command and communication is essential to system efficiency.

Rolling stock designs need to be cost effective and at the same time take account of the future passenger and freight requirements and be adaptable to this change.



IT systems that enable buying and selling of capacity in wagons and a reliable door to door track and trace of loading units and goods and real time information of the actual and forecasted train position will further attract the customer to rail.

For the freight customer, faster, flexible freight trains with performance similar to passenger trains will enable rail to deliver the reliability and cost-competitiveness that are key to exploiting market segments until now largely untapped by rail.

Faster freight services would be able to use passenger quality train paths and thus enable new business propositions. They would also support improved capacity utilisation of the network.

The technology of coupling, power distribution and braking will facilitate longer – 1500 metre – freight trains between mega hubs on main European freight corridors and beyond into the growing market with other regions such as Asia and the Middle East.

ENABLERS

- Full application of common requirements management (shared functional specifications)
- Common sector standards for the quality assurance methods in the development phase of rolling stock

- Standardised and modular architecture to facilitate interoperable infrastructure and operation
- Self-powered trains (energy provision and regeneration)
- Environment friendly technology (e-mobility, low noise)
- Potential of mechatronic technology to improve rolling stock
- Fitness for redesign and sustainability, i.e. modular white box approach and design-sensitivity against obsolescence: long-term stable standardised interfaces (mechanical, electrical, data, performance, etc.) inside rolling stock, between vehicles and with the infrastructure interface

Freight

- Better brake performance
- Introduction of central couplers for easier assembling and reduction of pull and stress forces between wagons
- Distributed traction power

Passenger

- New design concepts for future trains which will introduce tailor-made on board passenger information, new passenger services (providing a working and/or leisure environment), new commercial offerings, etc.

ENERGY SUPPLY AND CONSUMPTION

VISION

Rail provides an attractive and resource-efficient solution for sustainable mobility and transport and a significant contribution to reductions in greenhouse gas (GHG) emissions and dependency on oil.

OBJECTIVES

Powering the rail system is a constant task whether it is for traction power or for heating, comfort, lighting and other such operational needs. Rail will become a system that relies much less on the consumption of fossil energies whether this is by means of more and sustainably-sourced electrification of the system or by the means of alternative sources of renewable energy.

Even though rail is a very energy-efficient and green transport mode, research is needed on energy efficiency and eco-design to improve further the performance of rail. Rail has developed the “Moving Towards Sustainable Mobility, 2010”⁶ strategy which sets very high environmental performance targets.

The management of the rail system for minimum energy use and better traffic management based on the development of new technologies will enable energy savings and a better efficiency of the overall railway system.

Rail should develop a system which consumes energy but within which operations also generate energy to be used. Stations, terminals and other

THE SYSTEM AND ITS OPERATION

railway installations should use alternative energy sources wherever this is feasible for safe and efficient operation.

The promotion of environmentally adapted and efficient rail transport of passengers and goods is a key objective in Europe. Rail must improve societal understanding of the environmental advantages offered by the railway system in comparison with competing modes of transport.

ENABLERS

System

- Smart grids that aid the storage of energy and adaptive feeding
- Power supply infrastructure that provides harmonised management of the operational status of the electric railway from a core power-supply control network
- Sustainable energy procurement - careful consideration of environmental and societal aspects as well as the economic aspects when carrying out the investment process

- Monitoring and analysing the sector's emissions
- Understanding the impact on energy optimisation when developing timetables

Trains

- Recovery of energy from trains (regenerative braking systems)
- Minimising energy consumption through green driving techniques
- Zero-emission trains

Infrastructure

- The reduction of negative environmental impacts from materials
- Closed cycle waste management systems for a high level of recycling
- Plans to remove the historical legacy of existing infrastructure (e.g. creosote sleepers)
- Plans to reduce pollution from rail sources (e.g. chemical treatment against vegetation)
- Technology to reduce the intrusion of electromagnetic waves

6. For further information please refer to the strategic document "Moving Towards Sustainable Mobility" - <http://www.uic.org/spip.php?rubrique1638>



RAILWAY PEOPLE

VISION

The concept of the “forever open railway” depends on organised, reliable, well trained and professional people who enable the efficient operation of the system.

The railway sector is considered as one of the most attractive employers and the products and services it provides depend on skilled, committed and adaptable people delivering an efficient and customer-focused railway.

The rail sector attracts personnel who are motivated and committed to providing a modern, flexible and crucial service.



OBJECTIVES

As the pace of technological and technical changes accelerates, there must be a culture of continuous improvement, effectiveness and putting the customer first. People working in the rail sector must be equipped with the necessary skills to cope with the new technologies and techniques.

Technology advancements are designed to take account of the increasingly scarce human capital on the labour market. Future designs must consider the skills and capabilities available and demographic trends.

It is essential that rail is run as a system and so it is important that its people understand and adapt to new working practices, for example adopting the concept utilised by “High Reliability Organisations”⁷.

Developing the commercial and customer service skills of railway personnel is essential for attracting customers to use rail services.

The railway sector should therefore champion and develop technical railway schools. It should actively support the push for better gender balance in technical professions. Enterprises acknowledge the importance of investing in the personal development of every member of staff throughout their career to promote continuity in organisations and continuous quality improvement.

As the railway sector works increasingly in a business-like manner, it should benefit from a larger set of transferable skills. It needs to ensure that it has arrangements in place to draw upon a broader pool of skills from other sectors.

Rail must also utilise the expertise of universities, schools, industry etc. to offer best education / training opportunities for railway people to stay in or to enter the business and increase their knowledge.

ENABLERS

- A Europe-wide education platform for all levels (young professionals, experts, senior and top management) offering tailor-made programs that cover the needs of the sector to reduce people costs at company level
- A coordinated standardisation framework and a network of best practices to reduce the cost of implementing new products
- Research institutes, industry and the ROC are used to develop good products and import best relevant practice based on activities from other sectors/industries
- Product / concept deployment strategies that include explanations of the system and human impact and how to implement the innovation with human resources / existing knowledge

7. A High Reliability Organisation (HRO) is an organisation that has implemented proper measures to detect failures and weaknesses in a technical system before they result in serious degradation of the system.

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- Modern IT-based knowledge management systems to preserve and spread relevant information about railways and to structure and guide decentralised coherent collaboration, e. g. requirements management
- Assessment of the skills requirements for the future railway
- An open and balanced collaborative process for the recruitment and transfer of staff
- Improved learning methods to maximise benefits from new technology
- Technology and roles designed with people in mind and a clear idea identification of the user and what is her/his need
- The automation of repetitive and arduous tasks and management of the interface between man and machine

INFORMATION MANAGEMENT

VISION

The railway has a coordinated approach to the management of the information needed to run the operational system and keep customers informed about their journey and services available.

New revenue streams are based on improvements in the service to the customer, the exploitation of rail information and reduced operating costs.

OBJECTIVES

Delivery of a quality product to the customer depends on the provision of reliable information to the operational and maintenance staff. The information needed is, by and large, currently available but it is the process of bringing it all together and tailoring it to the customer that will provide value.

Customers of information are not only passengers and shippers - there are also internal customers.

Rail must be able to embrace all the varieties of information coming from the use of new technologies and to encourage the design of standard systems architecture and the integration of information systems throughout Europe. It must be capable of managing information over the life of assets, which varies a lot and can be more than a hundred years in some cases.

Real-time linked data and services published by everybody and everything on the web should be used to generate smart solutions to mobility problems of both Passengers and Freight.

Customers should enjoy continuous access to their personalised journey information systems and all



freight be traced and tracked in real-time through all stages of transit, whatever the mode. Data and business intelligence will play an important communications role, not only for broadcasting vital operational information to customers, such as train delays, but also for providing targeted offers and services to all customers. It is important that the customer has clear and reliable information, whether it is about fares and tariffs or alternative arrangements during service disruption.

By tailoring IT solutions, rail can be able to create a specific customer experience; by aggregating and analysing customer data it can identify trends and opportunities for new products and services.

Passengers must be able to enjoy seamless origin-to-destination journeys in a comfortable, safe and secure environment, reassured by the availability of real-time traffic and whole-journey information that keeps them abreast of their varying alternatives including inter-connection with other modes, should problems arise with their journey. Rail services

will adapt to customer needs, be attractive and easy to use.

The systems used by rail will allow passengers to plan easily the most cost-effective, time-efficient and convenient co-modal journeys.

ENABLERS

- Shared information platforms and robust IT tools that make possible real-time data exchange between rail service providers and other transport modes
- Production of common interface standards to ensure that the customer experience is seamless
- Coherent management policies and protocols, together with the clear identification of data owners and development leaders
- Support for the real-time management of a system that is resilient to external influences
- Customer experience applications developed for both passengers and freight, and brought to the customer by a vibrant competitive market of innovative, independent suppliers
- Access to continuous high-speed data, allowing passengers to treat their journey as a seamless extension of their working or leisure environment
- The concept of the end to end journey applies (journey/shipment planner, seamless/contactless ticketing/tariff arrangements, journey/shipment tracking)
- Seamless ticketing without queues or physical barriers at stations
- Electronic systems (smart phone etc) for revenue collection and security controls based on electronic systems
- New information technologies on board trains and at the station

SECURITY

VISION

Rail is the most secure mode of land transport. Customer reassurance levels are conducive to rail being an attractive mode of transport.

OBJECTIVES

There are a number of threats to the integrity of the operation of rail services that can be brought about by breaches in system security. By addressing these threats (such as metal theft or cyber criminality) in a multimodal way, rail will more cost-effectively address the main issues.

Increasing the level of security along the supply chain and between modes without hindering the free flow of persons and freight will facilitate the interoperability of transport security intelligence within and between transport modes. This type of data has considerable sensitivities surrounding it and a standardised approach across all transport modes would lead to a structured set of access conditions for data regarding transport security.

Increasing mobility demands will lead to more multimodal transport venues (stations, terminals, car parks, etc.). These are potentially attractive targets to criminality due to complex layouts and organi-

sational management structures. Multimodal transport will need an integrated security system. The development of security management systems at multimodal transport areas would provide a continuous security system approach independently of the transport mode used.



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In this multimodal context, minimising the effects of rail service disruption due to security events helps to prevent other modes from becoming overwhelmed by the cascade effect. A standardised and multi-modal approach to managing such disruption which rail would lead, will help to share the load and to minimise the impact of performance and recovery costs.

Rail should work with technology providers to develop more effective security equipment that can detect intrusion, aggression, vandalism, trespass, fraud etc. as well as more privacy-friendly solutions in existing technologies such as cameras etc.

ENABLERS

➤ System architectures - cyber threats could be minimised by resilient architectures and

by additional layers of security including sophisticated firewalls between operational systems

- Automatic back-up and dual redundancy should be built into all key systems
- “Internet of things” as a basis for emergency response
- IT systems such as those used by customers on trains or in stations, should be independent from key operational systems especially those with a safety-critical impact
- Active and passive systems to provide constant vigilance against terrorism and cyber-attacks, supplemented by trained staff
- Interfaces with security services and police and other law enforcement agencies

SAFETY

VISION

Rail is the safest mode of land transport and intends to remain that way. Rail will actively move towards being the safest mode of all transport sectors and thereby be very attractive to the customer.

OBJECTIVES

Rail has a very strong safety record and investments in interoperable technology will contribute to retention of that top spot. Safety of the system will be continuously improved through progressive automation of the CCC systems.

The operational risk caused by third parties at critical interfaces, such as level crossings, will be significantly improved

Critical interfaces will be effectively managed between all parties in the railway sector and the verification, certification and authorisation of safety management systems and vehicles will be easier and faster.

Close monitoring of the system will attract customers, reassuring them of their personal safety whilst using rail services.

Rail is the safest form of land transport and the sector will work to ensure that it remains so. Ensuring a clear interface between safety and investment and establishing a well-balanced link between cost and effect means that safety does not become a virtuous barrier to interoperability.

Having processes and automation in place is important but it is the human factor that can often be the weak link. This aspect must continue to be taken into account. The important task of training people to understand change and innovation and the impact on safety is imperative.

This is why the ROC must progressively implement quality management which spans around the whole system and its processes and not only focuses on conditions of technical products.

Mixing the human with the operational railway, especially in routine maintenance situations will become progressively less common. There will be a greater reliance on automated intervention and performance methods.



ENABLERS

- A range of continuous improvements and progressively automating systems such as Control, Command and Communication will lead to a positive impact on operational efficiency and safety and customer satisfaction and attraction
- Collaboration tools to foster the effective management of critical interfaces between all parties in the railway sector
- A harmonised process at European level for safety certification
- Campaigns to increase risk awareness
- Robust programs of level crossing closures
- Intelligent and consistently applied fall-back systems to assure safety during degraded mode designed into every critical sub-system and component

➤ DELIVERING INNOVATION PRINCIPLES AND PRACTICE

The dynamic and successful rail sector that this strategy supports will be one that works holistically and innovates to evolve, increasing its ability to compete, to retain existing and attract new customers. In this way, it can also contribute better to wider social and economic goals within the communities it serves. A strong international reputation for innovation will also act as a lever for the sector's contribution to the European export market in railway products, services and know-how.

A technical strategy relies not only on technological innovation but also on a culture of receptiveness to new ways of delivering customer service, and a willingness to challenge barriers. To maximise benefits, railways will therefore examine how best to facilitate change, including the establishment of advanced organisational and operational structures and systems.

Fundamental to delivering innovation within the railway sector is its ability and willingness to look outside its own bounds for the best and often most economic solutions, collaborating with technology developers and other specialists.

Increasing innovation within the sector requires incentives to be aligned better between stakeholders and along the supply chain. Such benefits could flow, for instance, from closer alignment of investment cycles and the development of improved value transfer mechanisms.

Reducing actual and perceived risk associated with technical innovation is important, as this is a major barrier to interoperability. Such risk may be operational, safety-related or commercial. Some risk mitigation methods already exist, but more should be developed.

Specific practical measures to support the delivery of innovation, bringing together the benefits of the ideas described in this technical strategy, include the provision of clear information on:

- Priority technical areas for innovation
- The range of funding sources
- Standards for new products, services and systems
- Access to industry expertise
- Access to development and test facilities

Whilst this RTSE is not a research agenda, the document is well placed to guide and inspire future innovation through the EU Framework Programme "Horizon 2020" to include the planned Shift²Rail initiative.

To facilitate the delivery of this RTSE for the sector, a well-balanced, business-led programme of innovation is essential. The use of instruments such as Shift²Rail will ensure that the necessary methodologies are available to support companies and the system in general to innovate.



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