INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

Research & Innovation Coordination Group (RICG)

UIC European Research and Innovation roadmap

Meeting: Energy and Efficiency WS, Rome – 4th October 2017

The Research & Innovation Coordination Group (RICG) – a brief presentation

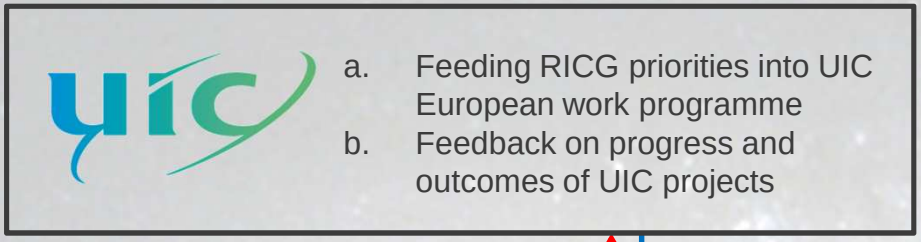
3 core missions

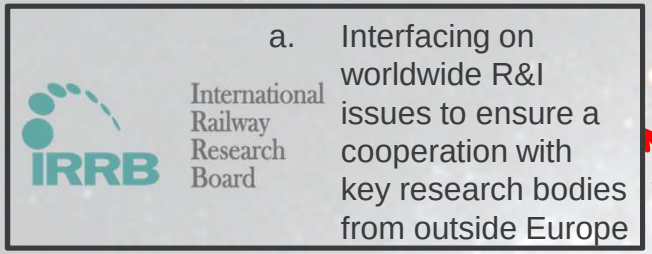
Preparing and updating the European Rail R&I Strategy from the Railway Operating Community (ROC) point of view

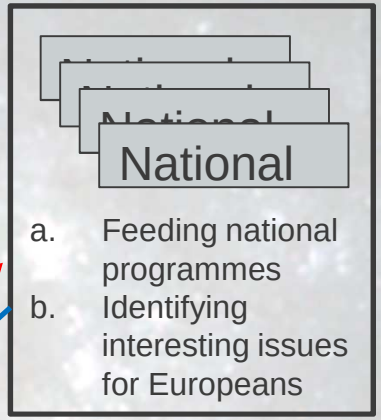
Sharing information on R&I activities

Liaising with other stakeholders within and outside the sector

RICG activities







RAE

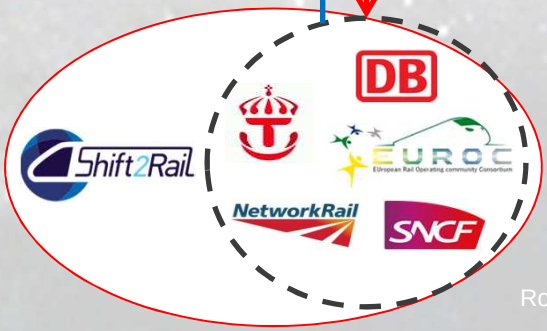
RICG

Others

a. Coordinating R&I priorities
b. Supporting ROC-led consortia for calls

a. Monitoring developments
b. Coordination of research needs and priorities
c. Supporting initiatives

a. Providing ROC common needs and vision
b. Feedback on evolutions



a. Collecting feedback from developments
b. Coordinating ROC contribution to them
c. Act as a vehicle for complementary proposals

Toward the vision

RICG decided to use the members companies‘ own R&I documents to build its common vision.

Capabilities:

Elements/situations which the ROC believes are essential and possible to develop and deliver for an efficient, smooth-running future railway system that fulfils and even exceeds customers’ expectations.

Capabilities approach: The logic behind

Companies Customer Expectations Documents

What is expected from the railways?

Customer Expectations

Strategic Goals
4 Cs:
Cost, Capacity, Customer, Carbon

Market needs
Market segments and challenges

Capabilities
Linking the high-level objectives and actual programmes through concrete targets

No solutions but a vision

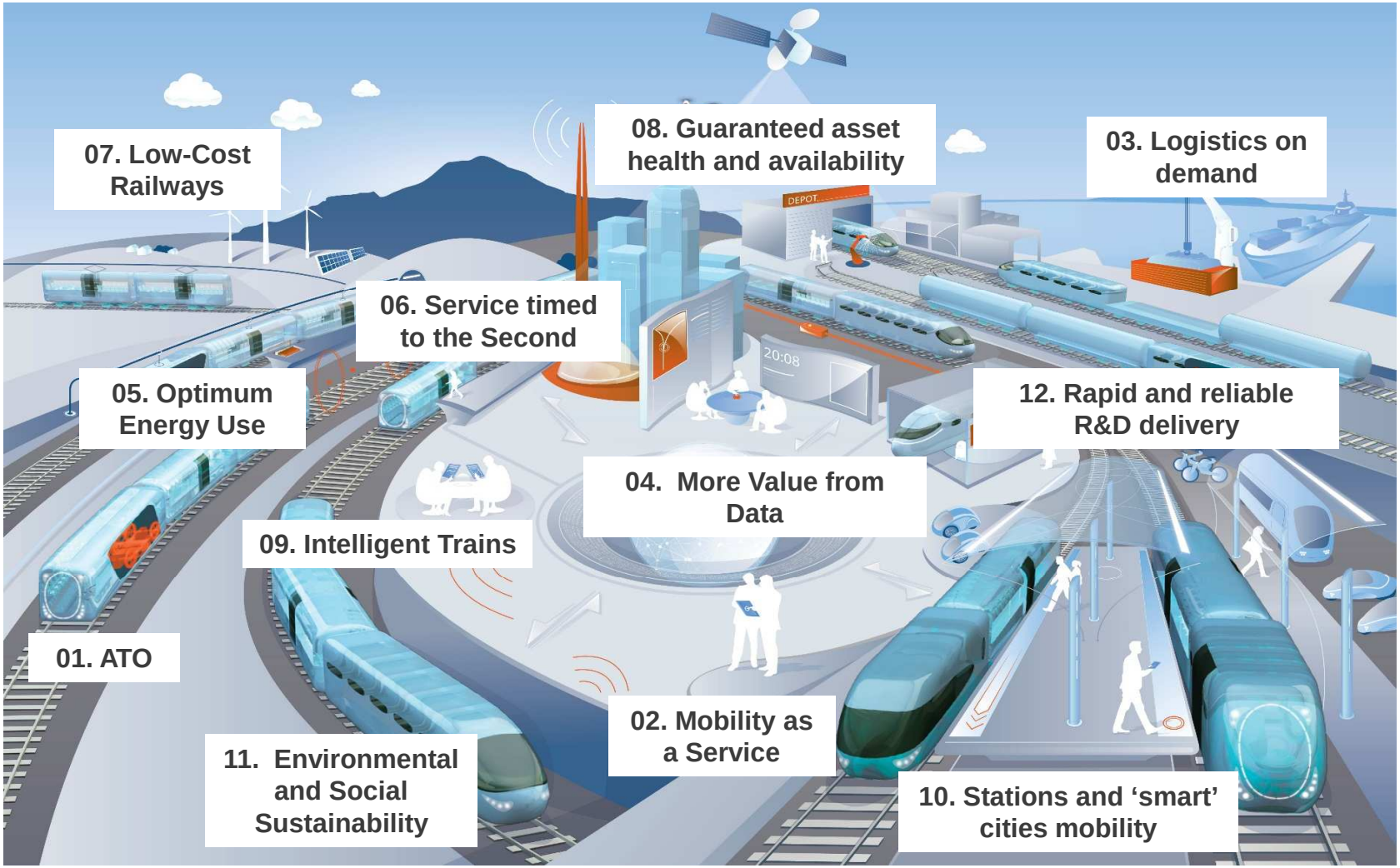
Where are the R+I Budgets/Resources allocated?

Investment programmes in new Capabilities

Portfolio Significant Programmes

Investment Projects
Illustrated in Portfolio Programmes; Solutions Catalogue; Shift2Rail & H2020 Projects

Capabilities for the Future European railway system



Temporary backgound picture courtesy of RSSB

Optimum energy use

- **Railways maintain their position as the most environment-friendly mode of transport by decreasing energy consumption.**
- **This is achieved together with lowered operating costs through the use of an intelligent energy management system.**
- **The introduction of new technologies and methods as supporting tools enable reduced and optimised demand-led energy use and energy efficiency.**

Optimum energy use
Elements

- Alternative propulsion concepts such as fuel cells are introduced. Hybrid powertrains allow running over non-electrified track sections. Discontinuous electrification at stations and on branch lines dramatically reduces the capital costs of extending electrification.
- Automated Train Operations (ATO) improves energy efficiency.
- Optimised on-board and line-side energy storage and charging technologies (e.g. dynamic wireless power transfer) allow the railway to redistribute energy throughout the system according to supply and demand.
- A high proportion of energy is recovered through regenerative braking, and small scale energy generation and harvesting technologies feed energy efficient trackside systems.
- A fully integrated system approach to intelligent energy supply maximises renewable energy generation and the use of smart grids, including those outside the railway system, through links with the wider energy supply sector.

R&I Strategic Clusters

The clusters highlight where within the system the capabilities will have an impact:

- **Customers and Markets**: the capability sets out to achieve customer satisfaction with the railway mode and its services; it allows railway companies to develop existing markets and to evolve new opportunities

- **Society and Economy**: the capability contributes to fostering social and economic integration thanks to the ability of rail to transport people and goods from A to B. Railways are economically sustainable in their operations

- **Environment and Energy**: the capability sets out to support environmental sustainability and encourages the procurement and use of clean energy

R&I Strategic Clusters

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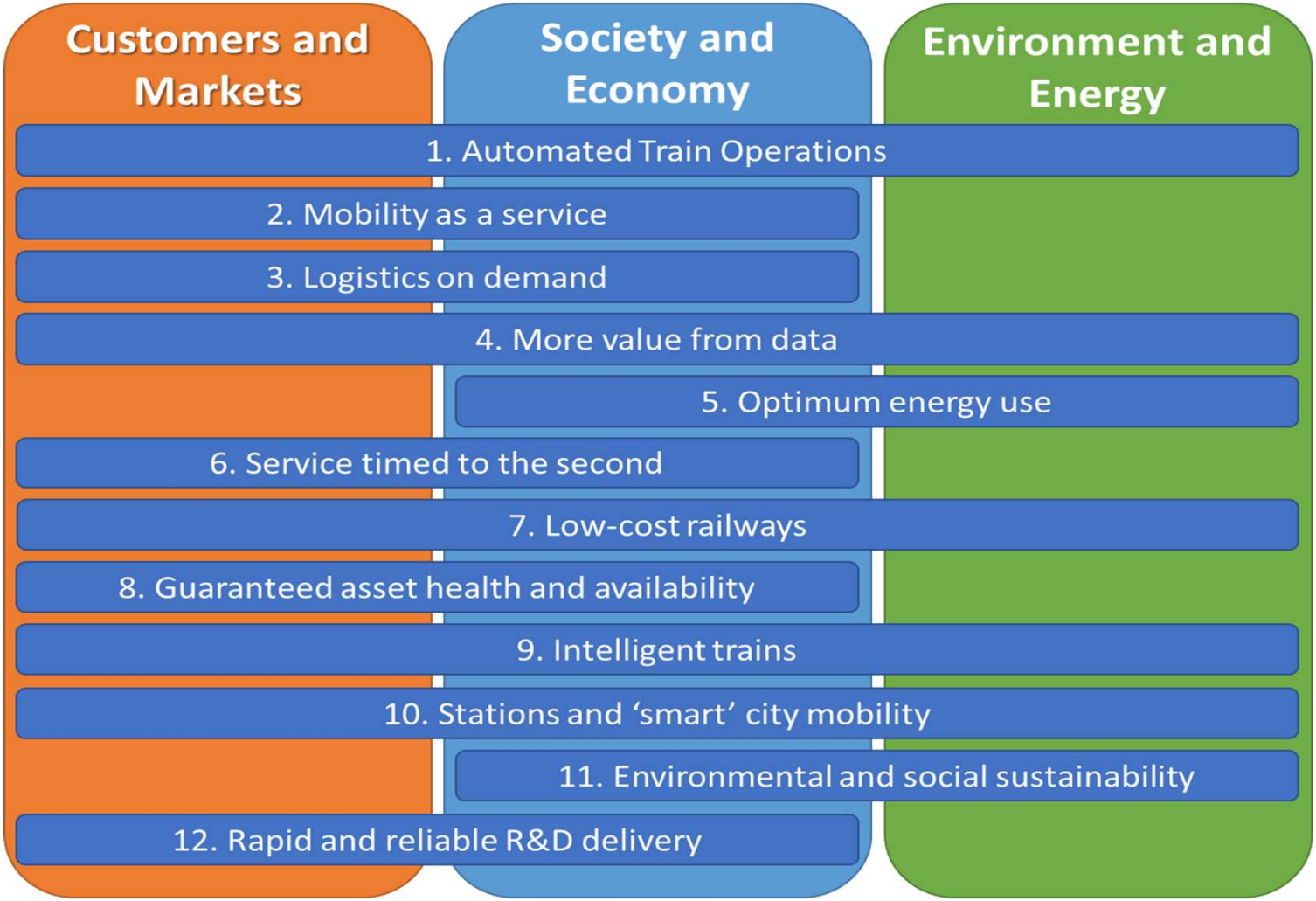

A last word on R&I sharing: the SPARK database

- SPARK is an online tool for the rail industry to find information on research and innovation. SPARK is provided by RSSB and supported by UIC through an MoC
- SPARK provides a library of over 22,000 reports, papers and test facilities
- It is a way of finding people, information, and how they are connected
- It is a way of sharing and promoting research
- SPARK helps you to understand **who** is doing **what, where**

SPARK

How SPARK works

- SPARK works on the concept of knowledge sharing. Anyone can register to access SPARK as a Reader, but those who can add content to SPARK are given elevated permissions and gain access to more records and reports.

- Through knowledge sharing agreements SPARK has grown to having a global contributor base.

SPARK can be accessed from:

www.sparkrail.org

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Thank you for your attention!

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BACK-UP SLIDES

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WG Vision & Strategy
Capabilities proposed by the ROC

1. Automated Train Operation
2. Mobility as a service
3. Logistics on demand
4. More value from Data
5. Optimum energy use
6. Service timed to the second
7. Low cost railway
8. Guaranteed asset health and availability
9. Intelligent trains
10. Stations and ‘smart’ city mobility
11. Environmental and social sustainability
12. R&D rapid & reliable delivery

Automated Train Operations

- **Trains are able to operate themselves and run closer together based on an automated train operation system, boosting the capacity significantly on existing lines.**
- **Autonomous and remote controls provide a safe operation.**
- **Rail operations are partly or fully automated.**

Automated Train Operations Elements

- Automated (passengers and freight) trains run closer together with increased flexibility.
- Passenger and freight train preparation processes are automated.
- Vehicles split and join on the move. New operational approaches (e.g. virtual coupling, convoying, reduced headway, communication between trains/units) are employed.
- Self-propelled automated/autonomous single units guide themselves through the system.

Mobility as a service

- **Customer demand-driven services lead the railways to provide excellent service within the overall mobility chain.**
- **Connections between the railways and the other modes are seamless, making mode interchange as simple and as efficient as possible.**
- **Information is permanently available to make travel safe and efficient along the travel chain including at stations.**
- **All customers and potential customers are connected to mobility services.**

Mobility as a service
Elements

- Tailored guidance to the best use of available transport services is provided so that each customer appreciates a personalised service
- Every journey is provided intelligently and seamlessly, with rail physically integrated with the other modes
- Continuous flow of information eases the journey, making connections between the different modes seamless
- Electronic ticketing and payment are the norm

Logistics on demand

- **Logistics services are driven by customer demand, with freight moved reliably in wagons designed to carry various loads.**
- **Better planning, tracking and shipment information capabilities combine to offer customers flexibility and capacity at reasonable, attractive prices.**
- **The rail system is fully integrated with the multimodal logistic chain.**

Logistics on demand
Elements

- Planing and scheduling are synchronised in real-time to customer demand
- Flexible, interchangeable, multipurpose and smart freight transport units increase handling flexibility and unit utilisation
- Shipments are moved effectively, efficently, safely and securely throughout the „physical internet“ logistic chain
- Freight trains are able to integrate within high-intensity passenger operations
- Automated yard, intermodal hubs, ports, and cross-modal interchange locations connect the rail system into the multimodal logistics chain

More value from data

- **To deliver on all the capabilities, rail manages a growing volume of data contributing to the data economy.**
- **Collection, analysis, interpretation and prediction are automated to provide consistent up-to-date information supporting fast, well-informed decisions and business benefits.**
- **This is achieved through a robust, resilient and secure information architecture and governance structure.**
- **Taking into account data privacy management, relevant information is shared across the industry and more widely, enabling the development of new services and applications to the benefit of the railway and its customers.**

More value from data
Elements

- Secure, robust, scalable and resilient open architecture and protocols allow full interoperability
- The Internet of Things (IoT) and Artificial Intelligent (AI) provide efficient capture, storage, management and interpretation of data
- The customer and the rail system communicate intelligently with each other
- Railway businesses exploit new data-driven revenue streams
- Big Data analytics enables a range of new and improved services to be developed state of the art cybersecurity ensures reliable and secure ICT services, protection of the rail system and business continuity in case of an incident.

Optimum energy use

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Service timed to the second

- **Situational awareness, where each train's location and speed is known at all times and in real-time, supports service operation timed to the second.**
- **This results in increased and enhanced operational flexibility and contributes to a more robust, resilient and reliable service as well as faster recovery from service disruption.**

Service timed to the second Elements

- Automated vehicle identification and monitoring is the basis of precise service operation
- Smart traffic management ensures every train is in the right place and travelling at the right speed
- Automated dynamic timetables are facilitated. Automated recovery from perturbation (a “self- healing” process) quickly restores normal service

Low cost railway

- **New models to deliver efficient and affordable infrastructure, rolling stock and railway operation allow the rail mode to be viable in areas of low demand and to compete for new transport links.**
- **Design, service solutions, technologies draw inspiration from other sectors such as light rail, automotive and aviation.**

Low cost railway Elements

- A low-cost, affordable rail system supports the rural economy. This is supported by the application of tailored standards.
- Simplified control-command system appropriate for low-intensity operation is used, allowing various degrees of autonomy.
- The use of lightweight materials for rolling stock reduces maintenance costs and energy consumption.
- A whole life operating cost approach balances the use of low-cost technical assets and good value service.

Guaranteed asset health and availability

- **Optimised maintenance keeps the railway continuously open, fostering minimal disruption to train services.**
- **Shared real-time monitoring of asset health by a wide array of sensors connected together in an Internet of Things (IoT) environment feed the predictive maintenance decision-making process.**
- **Asset health and availability is further improved by machine-learning, artificial intelligence and big data analytics.**
- **Robust modular units and infrastructure are easily maintained and repaired through a robotic automated system, making the operation punctual, safe and quick.**

Guaranteed asset health and availability

- The Internet of Things (IoT) enables real-time monitoring through connected sensors (ground/air/embedded)
- Artificial Intelligence (AI) supports predictive maintenance decision-making to reduce manual interventions on infrastructure and rolling stock
- Greater use of robotics, modularity and automation simplifies maintenance and reduces the number of components
- Remote maintenance of trains and infrastructure allows operations to continue uninterrupted
- Performance based service specifications encourages a diverse supply chain

Intelligent trains

- Intelligent trains are aware of themselves, their passengers/loads and their surroundings, knowing where they need to be and when, and able to automatically adjust journeys to meet demand.
- In addition, they intelligently feed information of infrastructure to support preventive maintenance.
- A network of fully intelligent trains can be self-regulating, negotiating vehicle to vehicle to resolve movement authorities and potential conflicts at junctions in the network and react to unexpected situations.
- The trains are also aware of and able to take account of the status of other transport modes.

Intelligent trains
Elements

- Autonomous trains can monitor and regulate themselves.
- Communications is possible between trains, between train and infrastructure and between train and passenger/freight customers
- Trains feature advanced mechatronics, reducing dependence on wheel conicity and permitting simplified running gear design.
- In-train signalling capability is used to resolve conflicts at junctions and stations.

Stations and ‘smart‘ city mobility

- **Rail is the backbone of urban mobility, with stations at the heart of ‘smart’ cities, being places to work, live, meet and communicate, where individual transport modes, including public transport and long-distance rail transport, are physically connected.**
- **New station designs provide easy access and seamless interchange between the transport modes, enabling railways to manage growing passenger volumes and mobility demands.**

Stations and ‘smart‘ City mobility Elements

- Railways are a core part of smart city mobility management systems and city fulfilment and delivery services. Stations are key to smart city governance structure and development plans
- Railways are connected to smart city mobility platforms for a seamless end to end journey within and beyond the city
- New designs of infrastructure and rail vehicles provide easy access and interchange between transport modes
- Flow management systems guide customers safely and efficiently through stations and to/from adjacent transport hub and city infrastructure, using dynamic way finding, barrier free access and multi-sensory information systems
- Platform management systems help passengers position themselves for their train and facilitate efficient boarding
- Security and revenue protection at stations and interchanges are based on electronic gates using smart wireless technologies, ticket detection systems and biometrics

Environmental and social suatainabillity

- **Railways continue to deliver sustainable transport solutions as overall travel demand intensifies.**
- **Rail makes an increased contribution to the transport economic mix, decoupling environmental harm from transport growth.**
- **Railways are able to operate with minimal environmental impact and with a low carbon footprint. Inclusive and easy access is available for all citizens to railway facilities, products and services.**

Environmental and social sustainability Elements

- Adoption of ‘circular economy’ principles enables the railway to move towards ‘zero-waste’ operation
- Sustainable and ethical procurement and production reduces the carbon footprint, with a whole life approach and focus on inputs to the system, recycling, transport of materials, renewable energy, operations and disposals.
- A climate change adaptive approach mitigates the impact of climate change on the railway
- Green technologies enable the railway to operate exhaust emissions free and with low noise and vibration levels.
- Information and accessible facilities put railways within the reach of citizens as an inclusive, affordable and accessible transport system

Rapid and reliable R&D delivery

- **An ecosystem for R&D, based on effective collaboration, the provision of greater technology demonstration capability and the rapid integration of technology into the railways, remove barriers to the adoption of new technologies and decrease time to market.**

Rapid and reliable R&D delivery Elements

- An R&D ecosystem with centres of excellence fosters a high participation in knowledge networks, opening new forms of collaboration, technology transfer from other industry sectors and keeping railway skill sets fresh.
- The sector has a strong commercial focus and awareness of the maturity levels of new technologies. There is a well-coordinated and fast decision-making process, reducing time to market.
- Virtual testing and efficient implementation processes speed up production and deployment of new products. There is close cooperation within the sector for standardisation and testing. Component-driven development, modularised products are key elements of a rapid deployment of innovation to the market. Railways have a permanent focus on disruptive technologies, using their challenges to increase their innovation capabilities and speed
- Agile development approaches, Labs, Hackathons, early involvement of customers are the elements of customer centric innovations. Open-labs invite end-users/customers to be part of the innovation process.