Transforming Europe’s Rail System
Moving European Railways Forward

Source: Sector High Level Paper

July 2020
Background

The European Commission requested this High Level Paper to:

• UNIFE / CER (with the technical support of UIC) / EIM / UITP / EURNEX / ERRAC
• S2R, other than the Union, Founding Members

S2R JU identified as coordinator and in supporting role
Context & Problem Definition: ERRAC

1. CHALLENGES FOR THE MOBILITY OF 2030

   - **ATTRACTION & CONVENIENCE**
     - End-user/citizen driven services (passenger & logistics)
     - Integrated door-to-door mobility
     - Minimising journey time, no waiting times
     - Punctual, reliable & secure
     - Comfortable & quiet
     - Affordable and tailored for all needs

   - **MAXIMISED AFFORDABLE CAPACITY**
     - Matching capacity with demand
     - Affordable and minimising infrastructure changes
     - Resilient transport system and quick recovery
     - Customised & Flexible: adaptable to changing needs

   - **SUSTAINABILITY/SECURITY**
     - Decarbonised mobility
     - Energy efficiency
     - Reducing congestion in populated areas
     - Limiting noise, vibration and ground space
     - More secure and resilient

   “The rail sector addresses these challenges as the backbone of integrated mobility”

2. THE RAIL SECTOR’S ANSWERS TO THESE CHALLENGES (Supported by Horizon Europe)

   - **DIGITALISATION**
     - Connected & integrated railways
     - Intelligent & cost efficient asset management
     - Cyber-security solutions
     - End-User/citizen-centric services
     - Digital control command

   - **AUTOMATION**
     - Real time operational management
     - Trains running closer together: Platooning & virtual coupling
     - Autonomous trains
     - Automated freight operation
     - AI & Robotics
     - Extracting value from data

   - **NEW MOBILITY SOLUTIONS**
     - Seamless integration between modes of transport
     - Smaller and more frequent trains
     - New types of rail transport solutions (pods & others)
     - Stations and terminals as mobility hubs

   - **SUSTAINABLE SOLUTIONS**
     - Green energy technologies
     - Interconnection between Energy and mobility systems
     - Apply digitalisation to energy
     - Silent railways
     - Pro-active security
     - Non-invasive inspection solutions

3. COST SAVINGS AND DEPLOYMENT OF INNOVATION

   Improved deployment, bottom-up transport-system standards solution, better adapted regulation/certification (virtual), rapid deliveries...
Common Vision, Objectives & Expected Impacts

European Green Deal: decarbonisation through sustainable and smart mobility

EU policy priorities
- A Europe fit for the digital age: Shaping Europe’s Digital Future
- An economy that works for people: New Industrial Strategy
- Europe in the world

EU rail policy objectives
- SERA: interoperability + safety + connectivity
- Guaranteed interconnected urban mobility driven by citizens’
- Passenger focused customer experience, accessible mobility
- Rail freight improved performance and competitiveness
- Faster modernisation of the rail industry including deployment

iPPP general objectives
- Integrated European transport networks
  - Urban
  - SERA
- Deliver multimodality
  - Connected and automated door to door mobility for citizens and freight users
- Delivering European rail industry competitiveness
  - Bridge the innovation “valley of death” through coordinating live, large-scale demos

iPPP specific objectives
- Deliver a European Traffic Management Layer that would cover the specific needs of mainline and urban services/operations
- Competitive green rail freight fully integrated into logistic chain
- Achieve mobility on demand
- Deliver a sustainable, safe and resilient rail system
- Bring into market new land guided transport solutions
Necessity for a European Partnership

Rail is a complex system of systems to deliver value to its customers, in terms of mobility and transport services. Mobility and transport solutions of the Green Deal rely on a rail system capable to meet the urgent needs of decarbonisation answering them together with other modes, delivering societal cohesion, integrating socio-economic developments with a systemic, smart and sustainable concept of operations. A new Rail R&I European Partnership Art. 187 TFEU is the strategic pillar to transform the rail system. Only through forward looking cutting edge, integrated and systemic research and innovation, it will be possible to tackle the complexities of rail and maximize the benefits of the R&I investment.

Requirements:

• Need to gather diverse expertise to bring innovation to the rail system
• Long-term commitment of actors involved on the basis of risk sharing and regulatory stability needs to be guaranteed
• Contribution to policy design and standardisation
• Efficient cooperation with other transport modes
• Synergies with other European and/or National Programmes
Delivering Integrated European Rail Networks

To deliver the Single European Railway Area bringing to the market an integrated, sustainable and digital rail system of systems, for the high-speed network, freight and commuter lines, integrating regional lines for the robustness and resilience of corridors operations.

Delivering multimodality

To deliver, upon the Green Deal ambition on an automated and connected multimodal mobility, “door-to-door mobility” and “on-demand door-to-door mobility” through the introduction of digital technologies, technological and operational solutions that would maximize the performance of urban rail transport, looking for synergies, and where needed integration, with rail mainlines services and other transport systems.

Delivering European rail industry competitiveness

To deliver through R&I excellence in tackling socio-economic challenges and ability “to demonstrate their impact in real life conditions,” and “the support to large-scale deployment innovations is instrumental to market uptake.”
Vision of the architectural layers for future system evolution

Service layer
- Shared and Integrated Rail Transport in a Sustainable EU Mobility System
- Freight on demand
- Door to door mobility

Network layer
- European Traffic Management Layer
  - Decision support with shared data
  - Functional system architecture
  - CDM
  - Digital twins

Transport layer
- Automatic & autonomous operations
- Zero barriers rail system
- Circular economy

Solutions layer
- Intelligent vehicle and digital infrastructure
- New land guided systems
- Zero emission system

Generate wealth
Data exploitation
Organise autonomy
Support innovation
Design, establish and initiate the operations of an ETML (European Rail Traffic Management Layer) and European Rail Network Manager: develop the operation management layer intended to optimise train movements (operations) at EU level, building upon the national and local systems.

Competitive green rail freight fully integrated into the logistic value chain, through data integration and common technological solutions applied to live pilot operations across EU to serve user needs.

Accessible and safe Mobility on Demand through zero barriers, physical and digital, rail system for passengers: - Mobility solutions for customers and citizens - High quality and safe (health) service barrier-free, including clear solutions for addressing PRM’s.

Deliver a sustainable and resilient rail system by developing zero-emission, silent railway system and climate resilient infrastructure, applying circular economy to the rail sector, piloting use of innovative processes/technologies/designs/materials in the full life-cycle of rail systems;

Bring into market new land guided transport solutions e.g. through concepts such as “pods”, “moving infrastructure”, “hyper-speed systems” and other disruptive ideas;
Rail R&I iEP funding EUR 1.5 bln (request)

Exploratory and Fundamental Research
- Integrating the research community, innovators/start-ups and other R&I institutions to work together with the rail sector to explore and generate new ideas
- EUR 200 million

Applied Research and Innovation
- Wanted market solutions will be pushed to move towards market deployment or terminated because not progressing as expected
- EUR 800 million

R&I Large Scale Operational Demos
- Integrated R&I activities to show the possible benefits that would come from the future European deployment of new solutions
- EUR 500 million

A R&I Programme estimated at EUR 2.5 ~ 3.0 bln
Target Groups & Stakeholders

• The operating community
• Manufacturers of rail systems
• Start ups
• The scientific community
• Freight forwarders and logistic providers
• Passengers

• Representatives of rail staff
• National Supervisory Authorities
• ERA
• EU standardisation bodies
• Sector Associations
Partners’ Composition

European Union and Core Members
- Listed in the Regulation
- Indicatively 15
- Participation in the full/large part of the Programme
- Balanced sector representation

Programme Members
- Commitment to part of the Programme: SMEs, suppliers, RC&univ, IMs/RUs and Urban Operators with R&I activities, other legal entities (technical bodies of the sector), etc.

Project Members
- Commitment to part of the Programme:

Other Project Partners
- Commitment to part of the Programme:

Any other third party
- It might join the programme at any moment for specific tasks or subcontractors or in specific areas outside the Programme membership
Resources

• **Members**: The overall investment made by the core members, in terms of Total Project Costs established in agreement with their usual accounting standards, is expected to be funded by the new Rail iEP at 50%.

• **Programme Members** in the forms of Project Members committed to performing some part of the Programme activities or Projects or different cycles of R&I. The model should be similar to the one for the core members, but with a lighter administrative process, with a **funding rate at 50%**.

• **Programme Members in the form of Other Project Participants** will contribute to the definition of specifications and possibly testing the overall results; the **funding rate might differentiate compared to the activities to be performed**.

• **Other Third Parties** will be subject to the H.E. **funding rates** for RIA or IA or CSA, mostly involved in lower TRLs or possibly in the highest ones.

• **Financial contributions** – beyond the net internal contributions to be provided by the different categories of members, it is expected that they would get involved with cash contributions to the running costs of the new Rail iEP based on the value of their net contributions, in a % estimated between 3 and 5%.
Governance: Lessons Learned from S2R JU

• Clear distinction of competences, to ensure the most appropriate delivery oriented approach and propose attractive ways to join the R&I work;

• Transparent, simplified governance structure: simple regulatory framework, to give the Governing Board the possibility to clarify the approach for programme implementation;

• Emphasize commitment over representation: incentivize the weight of SMEs and start-ups from across Europe;

• An effective and efficient decision-making process towards delivering an ambition Programme and,

• To take on board the programme members with a key role in defining the specifications and requirements of future rail systems, including urban, such as operators and infrastructure managers.
Governance

Work in progress

General Assembly
European Union (EC), Core Members, Programme Members, ED
Observers: SRG Chair, SC Chair, ERA

Guidelines
Suggestions for improvements
Endorsement of documents, recommendations

Reports
Documents for discussion
Progress of the Programme

Governing Board
European Union (EC) and Core Members, Executive Director
Observers: SRG Chair, SC Chair, ERA

Decision making body of the JU
Strong focus on strategic and operational activities
Stronger accountability of the Core Members in reporting on the activities

SRG
SC

SYSTEM PILLAR
SECTOR ADVISORY BOARD

PILLAR RESEARCH AND INNOVATION
ED PROGRAMME BOARD

ADVISORY BODIES
RAIL INTEROPERABILITY AND SAFETY COMMITTEE (RISC) MEMBER STATES

EUROPEAN COMMISSION (DG MOVE)
- Legislate (Interoperability/Safety Directives)
  - Strategic guidance on overall vision
  - Follow-up and monitoring
  - Mandates for TSI change and standardisation requests

S2R JU & Successor
Single coordinating Body for the sector to converge on the operational concept, the functional system architecture, and associated specifications and standards to fulfil the overall vision
Manages all EU funded Rail R&I
- operational concept
- functional system architecture,
  and associated...
- migration plans, pipeline of the future regulatory framework or standard, if and when necessary
- specifications and standards
- operational and technological solutions
- ....

ERA
Act as System Authority Deploy appropriate working parties
- assessment of S2R results
- additional specifications to be harmonised at European level
- TSI OPE
- harmonization of operational rules

RU & IM
- Needs
- Requirements, Specs
- Operations
- Services
- Etc.

Suppliers
- Design
- Development
- Systems
- Etc.

Others

Work in progress
An integrated Programme for a complex system

Transforming Europe’s Rail System Under HORIZON EUROPE

System Pillar

Fundamental research and « blue sky »
TRL: 0 -> 2

APPLIED RESEARCH
TRL: 3 -> 7

LARGE SCALE OPERATIONAL DEMOS
TRL: -> 9

Innovation Pillar

exchange

Partnership collaboration

Transforming Projects reaching TRL9

DEPLOYMENT ACTIVITIES
CEF / BLENDING /OTHER

Deployment Project

Deployment Project

Deployment Project

Deployment Project
Transforming Europe’s Rail System

- Integrated EU rail networks
- Door to door mobility for freight/passengers
- Innovation in the market

**System Pillar**

**A single coordinating body for the whole sector evolution**

- **Operational concepts**
- **Migration plans**

**Functional System of systems Architecture**

- Open interfaces to other transport modes & businesses
- System requirement specifications

**Innovation Pillar**

- Operational solutions for the services of the future
- Integrating project for a shared Rail Transport EU Mobility System
  - European Rail Traffic Management Layer
  - TSIs and/or standards pre-development

Transforming Projects (sub-system R&I implementations) & large scale operational demonstrations
R&I Programme: the System Integrating Project

- overarching the overall R&I activities, its interdependencies and future interfaces
- ensuring:
  - the definition of the new rail system in a seamless continuous transport service, achieving a *Reference Functional Rail System Architecture*:
    - for all the involved functional or technical subsystems (rolling stock, infrastructure, energy, CCS systems), their elements and their interactions
    - open interfaces to other transport modes and businesses providing connected IT services for their clients (for both Passenger and Freight segments)
  - accelerate interoperability and modularity while interacting on the operational rules’ changes towards a “one European vision”
  - the integration of the transforming projects and their interdependencies to ensure a maximization of the benefits
R&I Programme: the Transforming Projects

- ETML (European Rail Traffic Management Layer) and European Rail Network Manager
- Automated and/or autonomous and/or remotely piloted operations
- Railways Digital Twin, Simulation and Virtualisation
- Smart Asset Management and Maintenance of the Future
- Smart integration for door-to-door mobility
- Emerging Transport Models and Systems (Moving Infrastructure System (pods)/MaaS, hyper speed systems)
- Environmentally Friendly and Attractive Sustainable Mobility
- Rail as the backbone of a green freight logistic chain
- Network management planning and control
- Socio-economic area
- Safe and healthy mass transportation area