Deliverable 6
Executive Summary

Mega Trends

1. Executive Summary

The purpose of Work Package 6 in the SPIDER PLUS project was to identify and evaluate the mega trends that would shape the 2050 Vision of a society overwhelmingly served by electrified rail. It was recognised that the ways in which society evolves over the coming thirty seven years would have a major impact on future demands for mobility. Gaining an understanding of society in 2050 would necessarily involve determining the future needs of both business and consumers: their attitudes, values and behaviours; their goals and expectations; their work styles and life styles.

This purpose was achieved by gaining an understanding of the drivers of change which will, over the thirty seven year period, transform both the external environment and the rail industry; and, the counter forces of change which will impede the realisation of the vision.

It was recognised that the correct assessment of the drivers of change is crucial to the determination of a credible 2050 Spider Plus Mobility Vision.

A number of enabling drivers have been identified the impacts of which will be to create a climate which is conducive to the realisation of the vision's goals. A number of restraining forces have also be identified which will impede or arrest progress towards the goals.

Five specific themes were considered:

- **The role of networking in rail freight**
- **The role of networking and high speed in passenger rail**
- **The customer service in a seamless transportation chain**
- **Asset Optimization**
- **Eco-friendly mobility preserves resources**

The general conclusions drawn from our analysis of the drivers of change are as follows:

The achievement of the Commission's Vision for Rail by 2050 requires transformational changes in the political, social, economic, technological and environmental status quo in Europe. It is imperative that those changes are uniform, co-ordinated and efficiently implemented according to an agreed roadmap which identifies the key milestones and deliverables.

The current state of the railway infrastructure in Europe overall is such that multi billion euro investments will be required to raise it to the operational standards necessary for efficient, electrified rail services to be delivered throughout Europe by 2050. This investment will be derived from both public and private sectors; but, it is likely that the commercial sector will have to take the lion's share. Government must foster an environment in which such investment is attractive.

The realisation of electrified rail's full potential is also contingent on inter modality. Connections to roads, airports and ports is an imperative for both passenger and freight traffic. This will require a substantial degree of co-petition between companies and modes. A significant change in corporate culture, which is predisposed to aggressive competition, will be necessary.

Ultimately, the level of future demand for rail transportation will be determined by customers who have traditionally chosen other forms of transportation in the past. Customers must be convinced that rail is an attractive, affordable, fast, convenient and reliable alternative to road and air. The competitors are well established. The precursor is general public support for the funding and development of the railway networks.

The factors crucial to achieving the Vision for rail are judged to be:

- Adoption of new technologies to make rail more reliable and flexible
- Coordinated national government commitment & action
- Establishment of a genuine single market
- Inter modal transport services
- Liberalisation and harmonisation of transport and logistics sectors
- Lower cost electrified rail
- Substantial public/private investment
- Wide public support for rail
- Co-operative business environment
- A more appealing image for rail transportation

The critical restraining factors to be overcome are judged to be:

- Consumer attitudes and behaviours that ignore environmental concerns
- Car as a status symbol
- Decaying infrastructure
- Lack of public support for rail
- Nationalism/Protectionism
- Non-interoperable systems
- Resistance to change from national rail operators
- Underinvestment

1.1 The role of networking in rail freight

A principal objective of the SPIDER PLUS project is to demonstrate how rail can raise its modal share of goods transport with freight traffic over 300 km in the EU overwhelmingly served by rail services. The target market for a modal shift is road haulage. Rail freight services must be able to compete with road-only operations and geared to the needs of the customers who currently prefer road transport to rail.

An evaluation was conducted of the types of rail freight services which will be able to contribute to this modal shift target. The investigation provided clear evidence that intermodal rail/road transport services will have the greatest potential. This applies

particularly to commodities moved on continental trade lanes and to a lesser extent to container hinterland where rail already has gained a comparatively strong market position. On the other hand, it is anticipated that single-wagon traffic will not be able to deliver the necessary service level to catch existing road volumes, and the goods markets suitable for deploying conventional block trains are constrained and are not expected to grow above average in future.

It is assumed that road transport will not be subject to unjustified regulatory measures so the change of modal split can only be ensured by providers of rail freight services enhancing their service offerings.

<u>According to the results of the analysis the main prerequisites are as follows:</u>

- Efficient service offerings geared to "base loads" of shippers and LSPs;
- Inter-connected network of services to ensure a large geographic coverage for clients;
- Truck-competitive reliability and consistency of services;
- Road-competitive door-to-door costs.

Based on these findings and the anticipated capabilities and resources of the rail freight industry and intermodal service providers in particular; and by disregarding any major "revolutionary" changes in the industry itself and the regulatory framework; the key internal drivers of change in rail freight transport have been identified, which are considered to have a high occurrence probability and high impact.

From the ten internal drivers the following are considered to be the main drivers for a modal shift and thus are expected to be most critical for determining the future of rail freight services:

- Deployment and fast extension of use of automatic-coupling wagons;
- Horizontal collaboration of rail freight and intermodal service providers;
- Implementation of effective, cost-moderate production systems for bundling and split-up of wagon groups;
- Implementation of smart ICT management systems for the cooperation between actors; and for dispatching/deployment of operational resources;
- Industrialized production of services.

1.2 The role of networking and high speed in passenger rail

The most pressing challenges for passenger rail were evaluated. The main conclusions reached are as follows:

- Solutions have to be provided to cover the last-mile in passenger transport. The key is multi-modality for rail journeys: travel chains that provide the right mode of transport for each segment of a journey, incorporating supplemental modes where their efficiency is highest.
- Rail stations need to link different branches of a network to allow interchanges and to increase the accessibility of different destinations. Nodes need to function on a long distance journey just as well as in a regional context for connecting commuters, leisure travellers or shoppers.
- Services need to provide a high and consistent level of quality.
- Connections have to be fast and reliable, offer comfort for all types of journeys and travellers as well as provide connectivity to all related service offers. Using rail has to become considered "smart" for competing with the status symbol "car".
- Prices have to be competitive. The comparable price level of transport has to reflect all benefits and costs of the mode choice. Including effect on congestion and the environment.

Addressing these main issues will have a major influence on how the passenger transportation sector changes over time and how market segments within will develop. The question of how these challenges are approached will form the rail sector development in the next decades. For the analysis numerous drivers of change were cross-referenced, linked and prioritized into core drivers which provide a high level of impact on future developments, occurring with a high probability.

Infrastructures will be developed according to their efficiency. National planning for construction of new infrastructure will be highly cost oriented. Existing lines will be updated and capacity management will increase productivity of lines. The gaps in the European HS network will be closed. Rail stations will develop into hubs for different transportation modes with higher passenger throughput and more passenger comfort.

Modular train system will be the new standard. Further flexibility in train use and scheduling is reached; trains will be fully operable on the European network. New, lighter materials and overall material reduction will reduce footprint, recyclability, maintenance needs and construction costs of trains. Intelligent energy management will be essential in all new systems.

New information services will provide a constant stream of information pre- and on-trip. Up to date routing, navigation and connection predictions and calculations are available through personal devices as interactive applications as well as at info terminals in stations and in trains. International cooperation among service operators allows stronger competition with air travel and continues to build a connected network instead of isolated point-to-point relations.

Operators of HS rail will focus on demand development, capacity management and service efficiency. Flexible yield and capacity management systems enable operators to

extend services and invest in establishing new connections expanding their network. Advanced levels in operations and efficiency are enabled through powerful AI-assisted IT systems analysing real time data to forecast, improve and automate processes dealing with the big data challenge.

1.3 The customer service in a seamless transportation chain

This task identifies the customer´s requirements, the required service levels; the relationship between the business entities; the service gaps; and analyses causes and proposes problem solving measures.

The information technology that determines the customer experience in freight and passenger services has an important role to play if rail services are to gain a significant part of the market share until 2050. A "seamless travel chain" (passenger) and "seamless transportation chain" (freight) should be created by dedicated information technologies and comprehensive cooperation among the actors along the process chain. This task identifies drivers of change which are of potential importance for an improved rail usage.

Based on an analysis of the state of the art, the main drivers of change have been identified including their estimated impact respective to the shift to rail. They have a high impact on the railway market are listed below:

- The data availability in a common format on an electronic basis (TAP/TAF TSI)
- Increased usage and availability of mobile devices (online & GPS)
- Integrated service offer (e.g. customer service "Rail & Fly")
- Optimised interchange connections
- Increased availability of IT systems via one platform (e.g. Multi-modal "door to door")
- IT systems combining operational real time information
- Improved coordination and management of (international) train paths
- Integration of all possible and demanded transport modes within one station
- High performance hubs and nodes in transport chains
- Access of cargo airports to rail
- Increased infrastructure investment for dedicated rail freight corridors

In respect to mobile computing, some developments are considered as very likely. The usage of smart phones and other mobile devices will continuously rise. Considering the rapid development of mobile devices within the last twenty years, one can only imagine possible future mobile technology in everyday use in 2050. From the journey planning to the execution and aftercare, the smart phone or its successor will ascend to a future traveling companion. This monitoring supports travel planning and provides information during the trip on the projected arrival and additionally occurrences.

What applies to the passenger transport can also be derived for freight transport in principle. An improved accessibility to rail freight and the provision of highly reliable and

flexible solutions is of the highest importance for the competitiveness of the system, especially in market segments like the maritime and continental intermodal transport with truck traffic as a very strong competitor. The objective is to get to the same level of flexibility and accessibility and to even surpass it with regard to reliability. Therefore, in addition to the various hardware developments in other technical fields, this topic will focus on several identified core tasks to reach a new level of customer-oriented multimodal transport information and planning on the one side, and improved service planning and operation on the other, which also supports a better utilisation of the available capacity of infrastructure.

1.4 Asset Optimization

Today's rail companies are under growing pressure to increase the life of assets and minimize downtime from unexpected outages. Like other industries, rail operators competing with other transport modes, must operate efficiently, increase resource productivity and reduce operating expenses.

Asset management will aim for an alignment between the ways to operate assets and the objectives of the European Union and the Train Operation Companies / Infrastructure Companies. These objectives will be the operation of rail systems for the lowest life cycle costs and the lowest system costs considering environmental parameters.

Asset Optimization requires the consideration of system-wide implications when taking asset related decisions and the willingness for a cross departmental and cross company co-operation. That means for example that a track related asset decision taken by an infrastructure operator may affect the business of train operation companies.

For reaching the targets as defined in the SPIDER PLUS project, enormous investments have to be made. For this, it is assumed, that the EU will provide a framework in order to give planning certainty to the infrastructure companies as well as to the train operating companies.

In order to achieve these objectives, decision making methods have to be developed as well as rail system related policies have to be defined.

Considering the traditional approaches, an evolutional approach of asset management seems to be a promising line of action. For this the International Union of Railway is distinguishing three features as follows:

- Asset optimization is focusing on maintenance, renewal and enhancement activities on delivering sustainable outputs valued by customers and funding providers at the lowest whole life-cycle cost, as opposed to prioritising work predominantly according to conditions.
- It provides an integrating mechanism that crosses boundaries – between organisational functions and asset disciplines, and where relevant, between the infrastructure manager and contracting organisations.
- It places a greater emphasis on evidence-based decision making, using knowledge of how assets degrade and fail to optimise maintenance and renewal interventions.

The potential benefits from applying an asset management approach are numerous and significant. They include the creation of a line of sight between strategy and

implementation, the capability to deliver the same level of sustainable performance with reduced volumes of work, and the demonstration to external stakeholders that activities are being undertaken at the lowest whole life cost.'

Standardization and unified operational rules will become a key factor for reaching the targets. From ICT point of view, the traditional functional split between infrastructure along the tracks and the trains will change with increasing computing capabilities. The amount of needed infrastructure elements are going to decrease, at the same time as the remaining network elements as well as the rolling stocks will become more and more intelligent in terms of computing power, communication and safety capabilities.

1.5 Eco-friendly mobility preserves resources

The specific aim of this task is to appraise the managerial/commercial innovations which have impacts on the consumption of natural resources. Against the background of the drivers of change surveyed, an important part in this arena is played by the positive or negative effects of indicators like GHG-emission, noise, pollution and other external costs. Hence, the panel of drivers surveyed horizontally in the research has been analysed for how the impacts of these drivers will affect these indicators.

The selection of drivers connected with energy and eco-friendly mobility issues has been made according to the achievement of the following goals:

- ICT-tool driven transport services able to facilitate connections between modes at nodes, in order to foster the use of inter and multimodal transport (freight) and a plurality of passenger transport services
- Technological solutions allow the reduction of energy consumption and environmental pollution of transport modes
- The provision of modern infrastructure solutions (including infrastructure technologies such as signalling, etc.) allows the running of safer and energy-saving transport services
- Innovative business models and specific regulations enhance the spread of eco-friendly transport modes.

The selection underwent a peer review process conducted by a panel of experts, in which some further trends were identified such as the importance of the reduction of emissions as the main goal to be kept in mind in any eco-friendly mobility policy (which is something more demanding than the simple reduction of energy consumption); the role of ICT tools and internet that may decrease the demand of passenger mobility in the future; the need for long-term investment in new eco-friendly rolling stock for rail freight; and the role of smart grids.

The selected drivers have been described in the present report in order to highlight the importance of specific aspects of the 5 clusters identified, as follows:

- Energy efficiency and eco-friendliness represent characteristic elements for the vehicles of the future. Moreover, technologic development is exploring new fields related to driverless concepts, modularity, specialisation of vehicles, and

connectivity (between vehicles, with infrastructure, with people). ICT will contribute to the development of a new generation of private vehicles: connected, shared, driverless, with extended range and autonomous driving; this will lead both to higher competitiveness of cars and higher integration and eco-friendly transport chains.

- On the passenger demand side, transport services will be integrated in planning, booking, ticketing, information; energy efficient and eco-friendly multimodal options become more consistent and competitive.
- ICT developments in freight will perform faster and smoother communication; better integration of data and documents along the transport chain; enabling better competitiveness of multimodal chains with higher energy efficiency and environmental potential.
- More efficient and CO2-free city logistics through technical advances and regulation and efficient management of links between long range and last mile, will foster better performance for door-to-door multimodal chains.
- A step change in technology enhancement on all rail components is absolutely vital in order to provide competitive services matching user needs also at local level. A key goal is ensuring better comfort of trains and connectivity (seamless chains) at stations, thanks to technological applications.

The development of new business models is driven on the one side by the evolution of demand and user needs, and on the other by ICT and technological options allowing higher flexibility, customer responsiveness and overall environmental sustainability of the transport chains. The development of new forms of collaboration and competition such as integrated/local supply chains, joint ventures, regulated platforms, collaborative business models will define the future shape of the sector and influence its competitiveness and potential in terms of efficiency in the use of resources.

Infrastructure is a relevant and critical issue since infrastructure development will suffer lack of funding. Investments might be concentrated on main lines (high speed) and local rail networks might be substituted (e.g. by flexible road services). Integration will play a crucial role. Co-modality; better access to flexible services thanks to ICT; technological and organizational innovations; and the development of new business models have the potential to achieve higher efficiency in the rail core network services.

Measures and policies to enhance eco-friendly mobility represent a very important cluster of drivers which can contribute to the definition of the development path for future mobility schemes. In the medium term, regulation will instigate the take up of innovative eco-friendly solutions, while on a different level regulatory measures shall be designed to foster comprehensive integrated mobility services.

1.6 Europe faces major transport challenges

Those challenges include: rising traffic demand; freight transport is projected to increase, by around 40% to 2030 (compared to 2005) and by slightly over 80% by 2050. Passenger traffic is projected to grow by 34% to 2030 and 51% by 2050. There are also the linked challenges of congestion; fuel security, CO2 emissions and the need to create an efficient transport infrastructure to underpin growth in the European economy.

The future of European rail transportation must be considered against a background of challenge and change. It will not be business as usual. By 2050, almost everything in today's world will have been transformed including the challenges we face and the solutions we invent to address them; in the same way that today marks a major transition from forty years ago.

In 2050, we will be living in a hyper-connected, technologically intelligent world. The rail transportation system will have to undergo a profound transformation over the next forty years if it is to play its potentially crucial role in creating sustainable wealth and prosperity in Europe.