

ERRAC Work Package 02:

Encouraging Long-distance Modal Shift & De-congesting Transport Corridors:

The passenger roadmap

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ERRAC Roadmap

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1. Present situation

1.1 Scope of the Passenger Roadmap

The railway is an integral part of the transport system and is often interdependent with other modes in delivering door-to-door transport services. This roadmap focuses on longer distance (regional and inter-regional) passenger train services as part of a multi-modal, or co-modal, transport chain. Commuter, metro and light rail services are covered by the ERRAC Roadmap Work Package 03 - *Ensuring sustainable urban transport (including modal shift, light rail vehicles and metros) for Urban Mobility*.

If longer distance passenger services are to increase their competitive advantage over other modes they must deliver increased customer satisfaction: they must be attractive, efficient and affordable. This is vital if we are to meet ever more-demanding sustainability goals and to promote sustainable economic growth and the integration of Europe's regions. The key to reaching the sustainability goals is to achieve better connectivity.

This functions at three levels:

- developing ways of ensuring that passengers do not feel inhibited from using the rail system (e.g. physical ease of access, dealing with those things that potential users might perceive as threatening their personal security, readily manageable and user-friendly journey information and payment systems),
- promoting complementarity between different types of rail service and between those services and other modes (e.g. forging seamless links between high speed rail and urban transit systems)
- developing inter-connectivity between information systems, particularly those relating to information of the times and composition of services, fares, reservations and connectivity between modes.

If we are to achieve a significant modal shift the issue of both physical (how to get to the train station) and non-physical (ICT) interconnectivity must be addressed.

1.2 Overview

1.2.1 Rail's present position

Rail's modal share of the EU's inland passenger markets showed a small increase during the first years of the present century although it still accounts for only a minority share of movements. It is estimated that in 2010 rail accounted for 7.3% of passenger-kilometres[1]. Of course the vast majority of all journeys that people make are very short – less than ten kilometres. In addition to heavy rail, urban metro, light rail and tram trips also account for a

[1] DG MOVE presentation to the Rail Market Monitoring Study meeting, 22nd June 2011.

large number of shorter journeys, especially within urban conglomerations. However, rail commands a much greater share of longer journeys, particularly those in excess of 40 kilometres[2].

There is a notable significant exception to the relatively lethargic growth in rail's modal share of the overall market for freight and passenger transport. The increase in passenger traffic has been particularly significant in the high speed sector.

Italy was the first European country to inaugurate an HSL (on the *Direttissima* line between Florence and Rome) in 1977, although it is France that is generally recognised as the principal pioneer of high speed rail in Europe with the introduction of high speed services between Paris and Lyon in September 1981. Germany introduced its first high speed services at the beginning of the 1990s, with the Intercity Express (ICE), followed shortly after by Spain, which introduced the *Alta Velocidad Espanola* (AVE) in 1992. By the end of 2012 Europe will have over 8,000 kilometres of high speed route on which trains can run at speeds in excess of 250 km/ph.

The number of passengers travelling on high speed services continues to increase dramatically. Since 1990 there has been a six-fold increase in passenger kilometres travelled; well over 100 million passenger kilometres are now travelled each year. The 'high-speed' share in the total passenger transport market was 23 % in EU-27 countries in 2007; in France this figure is closer to 60 %.[3] Environmentally friendly and generally reliable high speed services have replaced air travel as the preferred mode on a number of key corridors.

The success of high speed service provision has not always been as great for trips between member states. International passenger rail services had experienced a serious loss of market share and image over the thirty years before high speed trains were introduced to them, in contrast to the growing shares being taken by air and private car travel[4]. Mystery traveller analysis revealed a number of the problems faced by international rail passengers:

- unsatisfactory information about the availability and cost of services,
- off-putting complexity of different national fares' systems,
- frequent lack of compatibility between reservations' systems and – with notable exceptions –
- generally poor perceived product offering compared to the air sector.

High speed international services, such as *Thalys* and *Eurostar*, now have the major market share of their key links. This success underscores the potential of high speed international rail

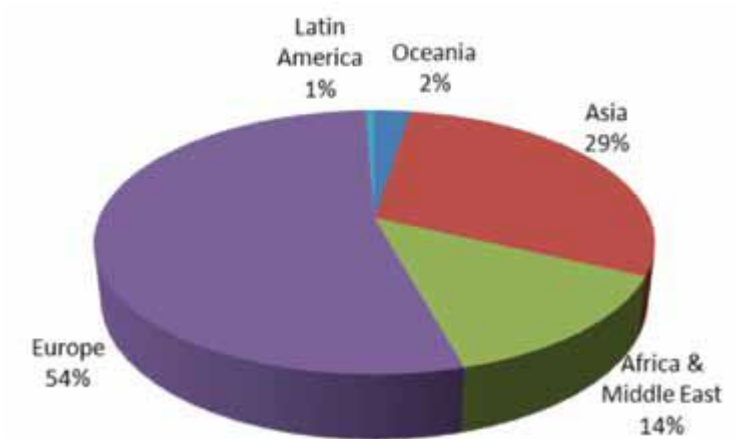
[2] See, for example, the UK's *Great Britain National Travel Survey, 2010*, Table NTS0308: This indicates that in Britain for such journey lengths (which account for approximately one third of all rail trips) rail's modal share more than doubles to around 20%.

[3] *Ibid*, Section 4, paragraph 26

[4] *Developing EU (International) Rail Passenger Transport: assessment of the actual and potential market for international rail passenger services*, OGM, Final Report for the European Commission, 2002

travel. However, operators face significant and costly barriers to market entry. These include the challenge of providing a reliable yet affordable service with rolling stock equipped to cope with technical standards that differ between member states or even over parts of the route within a member state. This fragmentation must be overcome if Europe's passengers are to benefit from a single seamless market for passenger services, as well as from the potential economies of scale that currently elude Europe's world-leading railway industry. Investment in a reliable and affordable Single European Railway Area is essential both for users and the sector as well as for the delivery of Europe's growth agenda.

The European railway industry currently supplies more than 50% of the worldwide production of rail equipment and services. The total accessible world market for the rail industry in 2009 was estimated at more than €136 billion[5]. Despite the global economic problems, annual growth of the world rail market has continued at around 6%. This has been stimulated by the success of high speed services in Europe, European industrial leadership in metro network technology and the attractions of ERTMS, which is now recognised as a global standard. By April 2012 about 62,000km of track worldwide was equipped with ERTMS or so contracted[6]. ERTMS outside Europe now accounts for almost 50% of the trackside investments.



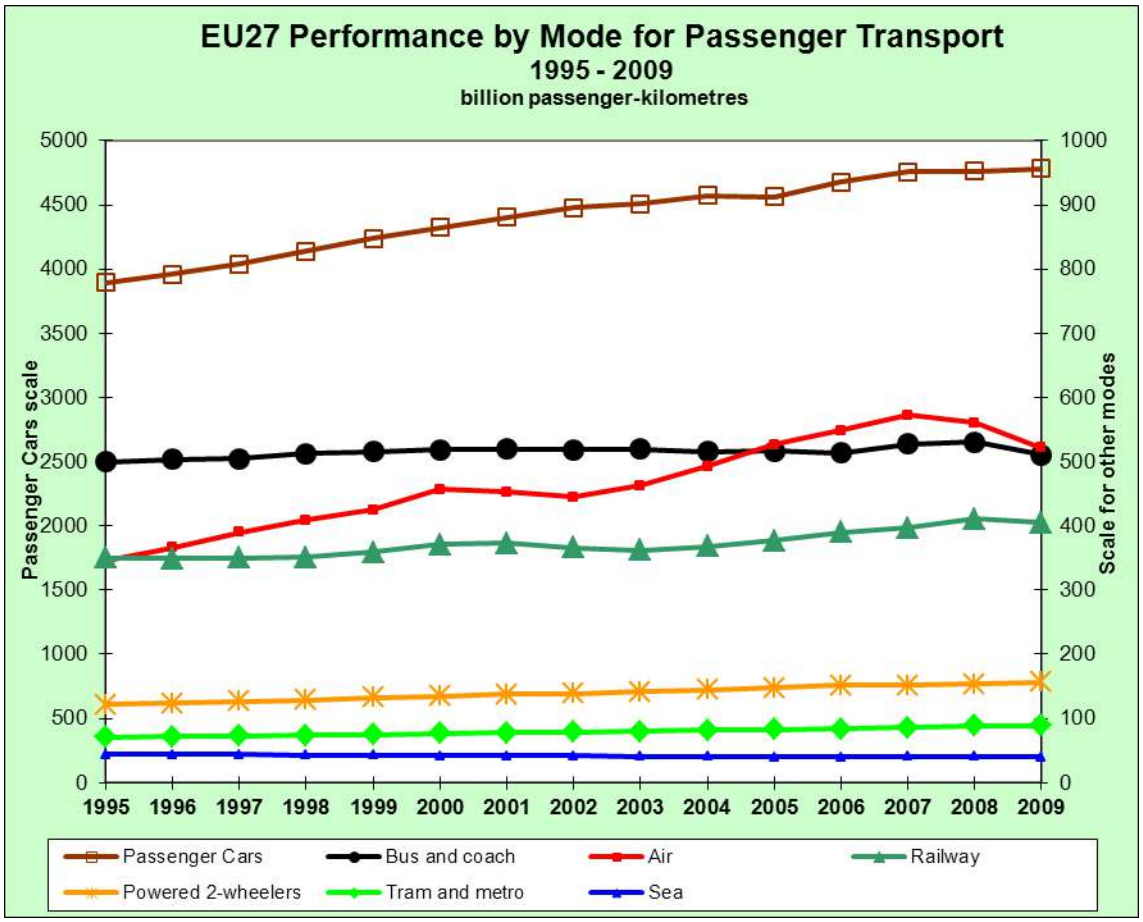
*ERTMS investments worldwide, by geographical area (in lines km), April 2012 – **Source**: UNIFE*

1.2.2 Rail's market share:

There has been steady growth since 1995 in the number of passenger kilometres travelled by train in the EU-27. The increase was more than 15%. Tram and metro travel increased by over 25% during this period (more than the increase in passenger car usage) while air travel increased by around 50%.

[5] UNIFE World Rail Market Study, 2010

[6] www.ertms-online.com



Source: *EU Transport in Figures, Statistical pocketbook 2011*, European Commission, ISBN 1831-998X

However, despite the significant increase in passenger kilometres travelled, with a modal share of around 7% in 2009 rail only just managed to maintain its relatively small share of land travel. At 6% its share of all travel, including travel by air and sea, was inevitably smaller. Rail's share of medium distance journeys is rather higher while air dominates longer distance travel.

There is a significant difference in the development of rail travel over the last twenty years between the countries of the EU-15, where the number of passenger kilometres travelled has increased by over a third, and the newer member states of the EU-12 where, by 2009, passenger rail patronage had fallen to one third of its 1990 level. In the EU-27 overall rail patronage has returned to the same level on passenger kilometres travelled in 1990 – a little more than 400 billion passenger kilometres.

	Passenger Cars	P2W	Bus & Coach	Railway	Tram & Metro	Air	Sea
1995	*73.1*	*2.3*	*9.4*	*6.6*	*1.3*	*6.5*	*0.8*
1996	*73.1*	*2.3*	*9.3*	*6.4*	*1.3*	*6.8*	*0.8*
1997	*73.1*	*2.3*	*9.1*	*6.3*	*1.3*	*7.1*	*0.8*
1998	*73.2*	*2.3*	*9.1*	*6.2*	*1.3*	*7.2*	*0.8*
1999	*73.2*	*2.3*	*8.9*	*6.2*	*1.3*	*7.3*	*0.7*
2000	*73.0*	*2.3*	*8.8*	*6.3*	*1.3*	*7.7*	*0.7*
2001	*73.3*	*2.3*	*8.7*	*6.2*	*1.3*	*7.5*	*0.7*
2002	*73.8*	*2.3*	*8.6*	*6.0*	*1.3*	*7.3*	*0.7*
2003	*73.7*	*2.3*	*8.5*	*5.9*	*1.3*	*7.6*	*0.7*
2004	*73.6*	*2.3*	*8.3*	*5.9*	*1.3*	*7.9*	*0.7*
2005	*73.0*	*2.4*	*8.3*	*6.0*	*1.3*	*8.4*	*0.6*
2006	*73.0*	*2.4*	*8.0*	*6.1*	*1.3*	*8.6*	*0.6*
2007	*72.8*	*2.3*	*8.1*	*6.1*	*1.3*	*8.8*	*0.6*
2008	*72.7*	*2.4*	*8.1*	*6.3*	*1.4*	*8.6*	*0.6*
2009	*73.5*	*2.4*	*7.8*	*6.2*	*1.4*	*8.0*	*0.6*

Development of modal share in the EU, 1005-2009[7]

Notes:
Estimates (*in italics*)
Air and **Sea**: only domestic and intra-EU-27 transport; provisional estimates
P2W: Powered two-wheelers

High speed rail accounts for over 25% of all rail passenger kilometres[8]. The increase in traffic has been particularly significant in the High Speed sector: here, the number of passenger kilometres travelled doubled over the ten years to 2009. The length of line or sections of line on which trains can go faster than 250kph more than doubled over this time. By 2010 6602km

[7] *Source: EU Transport in Figures, Statistical pocketbook 2011*, European Commission, ISBN 1831-998X tables 2.3.4, 2.3.5, 2.3.6, 2.3.7,

[8] *Source:* UIC. High speed rail transport covers all traffic with high speed rolling stock (including tilting trains) able to run at 200kph.

of high speed line were in use. More than a further 1800km of line were due to have come into use by the end of 2012.

The development of dedicated High Speed lines can bring wider benefits. Capacity may be freed up on existing conventional lines or, with the separation of freight and passenger services, the creation of dedicated freight-oriented corridors facilitated.

1.3 Policy drivers

This theme that *"People are at the centre of EU transport policy"* [9] underscores the European Commission's latest Transport White Paper[10]. It sets out a comprehensive strategy (Transport 2050) for a competitive transport system that is intended to:

- increase mobility;
- remove major barriers in key areas;
- fuel growth and employment;
- reduce Europe's dependence on imported oil;
- secure a cut in carbon emissions from transport activities by 2050 of around 70% compared to 2008 levels.

To achieve this, the strategy envisages that by 2050 the majority – more than 50% - of medium-distance[11] passenger transport should go by rail. This represents a multi-fold increase

[9] Page 9, European Commission staff working document accompanying the White Paper – *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport* system, , SEC (2011) 391, Brussels 28th March 2011

[10] COM(2011) 144 final

[11] There is no single definition of what is meant by 'medium-distance' the White Paper. Footnote 57, discussing freight movement, refers to distances between 50 and 150km while paragraph 403 describes medium-range as distances below 300km. In contrast paragraph 98, discussing HS rail, mentions distances below 1000km. This equates to a high speed service journey time or around 4 hours. This is a rail journey duration that is increasingly regarded as competitive to air travel because of extended security checks at airports, road congestion around airports and declining time-keeping by airlines while rail passengers are often more easily able to work when travelling (see, for example Nash, Chris, *When to Invest in High Speed Rail Links and Networks?*, Joint Transport Research Paper 2009-16, Leeds, 2009 and also the widely quoted remarks of Guillaume Pepy of SNCF who is cited as the previously 'magic' three hour threshold has now become four or even five hours. SNCF has captured half of the traffic on the five-hour Paris-Perpignan route. Deutsche Bahn's spokesman, Andreas Fuhrmann, is reported as having even talked of a six-hour tolerance.).

on rail's present share of passenger travel which is around 7%[12]. The absolute scale of this growth is compounded by the anticipated continuing growth in travel volumes.

The high-speed rail sector is already showing that it can help drive modal shift: the 'high-speed' share in the total passenger transport market was 23 % in EU-27 countries in 2007; in France this figure is closer to 60 %.[13]

The European Commission acknowledges that new mobility concepts cannot be imposed on Europe's citizens[14]. It also accepts that curbing mobility is not an option[15]. In other words, modal shift will depend on making rail more attractive to passengers. The sector will have to find ways of making rail's case for a bigger share of the public purse more compelling to taxpayers if essential investment is to be delivered.

If rail is to be the mode of choice for the majority of medium-distance journeys it needs to be able to offer passengers a service that dovetails with other modes in offering seamless end-to-end journeys. It must be reliable, offering services of the right sort and at the right time for the wide variety of passengers, including those with reduced mobility or who are unfamiliar with the workings of the European rail network as well as premium-fare business travellers who need to use the train as an extension of their office.

Rail must also offer value: if the services that it provides don't satisfy passengers there is little prospect of realising the Commission's ambitions for a dramatic modal shift away from less sustainable transport modes. Many passengers today rely on rail because there is no practical alternative – too often rail is used by passengers as a distressed choice. Worsening road congestion and the spatial pressures of increasing urbanisation will almost certainly ensure a continuing market for its services.

Just to meet the bare necessities is insufficient in a consumer-oriented, democratic society. Businesses must respond to consumers' needs and aspirations if they are to thrive. Services of general interest must ensure that they provide a good quality service at an affordable price, everywhere, for everyone if they wish to command appropriate public funding.

The challenge is to make rail the mode of choice for the majority of journeys; this way it can be the sustainable backbone of the European transport area. This Work Package addresses the challenges in encouraging long-distance modal shift to rail and enabling decongestion of transport corridors.

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[12] Brussels, *Report from the Commission to the Council and the European Parliament: Second report on monitoring development of the rail market*. 18.12.2009 COM(2009)676 final

[13] *Ibid*, Section 4, paragraph 26

[14] COM(2011) 144 final: Section 1, paragraph 48

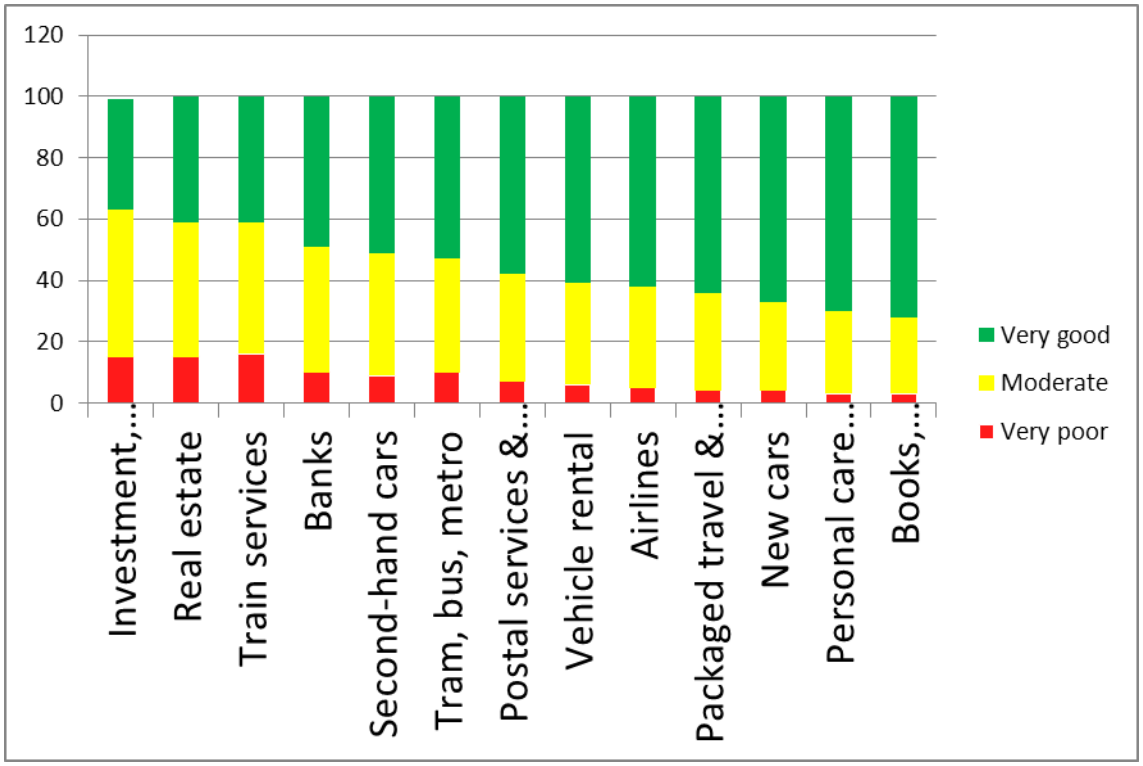
[15] COM(2011) 144 final: Section 2, paragraph 18

1.4 Attitudes to rail

1.4.1 Public attitudes towards the rail sector

The rail sector does not score well with the public in comparative measures of consumer satisfaction. This is potentially significant if politicians are to be persuaded to devote a higher proportion of public spending towards investment in the rail sector, particularly in the provision of the new infrastructure, rolling stock and traffic management systems that will be required to accommodate the anticipated multi-fold growth in market share.

Each year DG SANCO of the European Commission publishes a *Consumer Markets' Scoreboard* which measures public satisfaction with the performance of different services. Train services rank very nearly at the bottom of the chart, together with providers of investment and pension services and real estate agents – even below banks and second-hand car dealers. Airlines and new car salesmen, in contrast, are in the upper quartile of satisfaction.



Relative consumer satisfaction with rail services in the EU
Source: Consumer Markets' Scoreboard – Making Markets Work For Consumers – SEC(2010) 1257[16]

[16] http://ec.europa.eu/consumers/consumer_research/editions/docs/6th_edition_scoreboard_en.pdf

1.4.2 Users' attitudes towards rail services

The European Commission has published the results[17] of a passenger satisfaction survey conducted amongst representative samples of rail passengers aged fifteen years or older in each of the twenty-five EU member states with a rail system. The research field-work was carried out by Gallup in March 2011. Rail passengers were interviewed about their satisfaction with various features of rail services, including trains and train stations in their country.

Somewhat more than 8 in 10 rail passengers were *very* or *rather satisfied* with their personal security on board trains in their country; this figure was somewhat higher than the one observed for security in railway stations. The length of time a journey was scheduled to take (i.e. the estimated travelling speed of trains) was considered *very* or *rather satisfactory* by 78% of rail passengers.

More than three-quarters (78%) of rail passengers were *very* or *rather satisfied* with the comfort of seating areas in trains in their country; however, the proportion being *very* or *rather satisfied* with the seating capacity in railway carriages was considerably lower (67%).

56% of respondents said they were *satisfied*, and 41% were *dissatisfied*, with the maintenance and cleanliness of railway carriages. The cleanliness and maintenance of railway carriages was the aspect that most frequently appeared in countries' top three of features that passengers were the most likely to be dissatisfied with.

When asked about the punctuality and reliability of trains in their country, 66% of rail passengers said they were *very* or *rather satisfied*. Although the same proportion (66%) of rail passengers were *very* or *rather satisfied* with the availability of staff on board trains, a considerably lower level of satisfaction (56%) was measured for the provision of information on board trains, particularly in case of a delay.

Of the eight features of train stations (as listed in the survey), rail passengers across most countries were most likely to be satisfied with three of them:

- ease of buying tickets,
- the provision of information about train schedules and platforms, and
- personal security in the railway station

although it should be noted that even here there were some significant variances. For example, in Germany barely half of passengers in the sample were recorded as either very satisfied or rather satisfied with the ease of buying tickets in contrast to the situation in other large countries such as France, Italy, Spain, and the UK where satisfaction levels of around 85% were recorded with more than 50% of the sample being reported as very satisfied.

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[17] Flash Eurobarometer No 326 – *Survey on passengers' satisfaction with rail services*. European Commission, 2011

These results may need treating with caution. Research in Britain by Passenger Focus, the national statutory passenger consumer body, amongst passengers on ticket retailing, indicates considerable unease amongst passengers with what is seen as the complexity of the fares' system and ticket validities, the problem of getting the most appropriate ticket for the journey and passengers' concerns about whether they get the best and same value from different types of outlet such as station ticket offices, on-line, ticket vending machines etc.[18].

Three other features were identified as ones with which rail passengers – across most countries – were most likely to be dissatisfied:

- car parking facilities,
- the quality of station facilities, and
- cleanliness and maintenance of such facilities.

There are some similarities between this research and the large sample National Passenger Survey[19] that is carried out twice a year amongst an annual sample of over 50,000 rail travellers in Britain. This is used to obtain a country-wide analysis of passengers; satisfaction with rail travel. This research has demonstrated that passengers' priorities are focussed on:

- receiving a punctual and reliable service,
- the provision of sufficient capacity, both in terms of train frequency and the availability of seating on board the train,
- getting value for money,
- the effective management of disruption, especially through information to passengers,
- the availability of accurate information about train times and platforms,
- the comfort and adequacy of accommodation, especially on longer distance journeys,
- the availability of train and station staff,
- the ease of buying the most appropriate ticket,
- ease of access to services for passengers with reduced mobility.

Punctuality and reliability are rated by passengers as by far the most important of these considerations.

1.4.2.1 Performance

Punctuality is of key importance for rail passengers. Research undertaken by Passenger Focus amongst rail passengers in Britain shows that it is the main influence on overall journey satisfaction[20] and one of the top three priority areas for further improvement[21]. This has led to

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[18] See, for example, *Ticket vending machine usability*, Passenger Focus, 2010, *Ticket retailing: website usability*, Passenger Focus, 2011, *The Great Western Franchise*, Passenger Focus 2012.

[19] Passenger Focus: *National Passenger Survey.*
http://www.passengerfocus.org.uk/research/statistics/content.asp

[20] National Passenger Survey - Drivers of Passenger Satisfaction, Passenger Focus.

an investigation of how customer satisfaction with punctuality is affected by the actual level of delay that a passenger experiences. The research revealed that, amongst Britain's rail users, satisfaction with punctuality reduces by two or three percentage points for every minute of delay. Shorter distance commuters, who are already likely to be the least satisfied of passengers, are least tolerant of delay: they notice delay after as little as one minute. Long distance commuters and business and leisure passengers tend to change their level of satisfaction with punctuality after four to six minutes[22]. Passenger satisfaction may also be adversely affected by a rail operator's failure to provide advertised services of such things as buffet facilities, seat reservations etc. Consistency in delivery of those things that the operator says they will provide is appears to be a vital element of passenger satisfaction.

1.4.2.2 Capacity

The provision of sufficient capacity at the time when the passenger wants to travel is another important determinant of passenger satisfaction. It is partly a question of providing an attractive, functional passenger environment with a high level of comfort for all, drawing on a deeper understanding of passengers' behaviour, needs and perceptions[23]. The Gröna Tåget research dealing with passengers' behaviour and preferences concerning the on-train passenger environment underlined the importance of vehicle concept in influencing whether more people choose to travel by train: this included an examination of the suitability of different types of seat, table and luggage storage design, measures to improve the functionality of journey time (e.g. refreshments, computer connections etc.), heating and ventilation and the specific design requirements of people with reduced mobility or of different passenger markets (e.g. commuters, business passengers, etc.). Similar research has been commissioned by Passenger Focus in Britain as a contribution to the rail sector's plans for the design and introduction of new trains[24]. Frequency, seating capacity, the provision of through services and the stopping patterns and times at which services are offered is also important.

1.4.2.3 Seamless end-to-end journeys

The rail-leg of a journey is frequently only one part of a trip. Growth in passenger numbers will mean that more and more passengers are likely to make use of connecting modes. This is of particular significance when making plans for co-modal hub stations, exploiting integrative

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[21] Passengers' Priorities for Improvements in Rail Services, March 2010, Passenger Focus.

[22] *Improving Punctuality for Passengers*, Passenger Focus, January 2011

[23] See, for example *Gröna Tåget*, *Trains for tomorrow's travellers*, and *Attractive and Efficient Train Interiors* Trafikverket, Bombardier Transportation and the Swedish Royal Institute for Technology, KTH

[24] See, for example, *Designing the Future*, MVA Consultancy for Passenger Focus and Transport Scotland, May 2010 as one of a series of Passenger Focus commissions in this area that are in the public domain.

architecture or developing user-friendly ways of providing both advance and real-time information for those planning or making a trip. The return from significant investment in improved journey times over the longer-distance leg of a journey is undermined if insufficient attention is made to the suitability, availability and accessibility of connecting local journey legs for the first or final stages of a journey.

1.4.2.4 Satisfaction and perceptions of value

Not all criteria will have the same importance in a passenger's mind; some things are more likely to determine levels of satisfaction and dissatisfaction than others. By identifying the factors that correlate most highly with overall satisfaction it is possible to identify the main drivers of passenger satisfaction. Drawing on the twice yearly British National Passenger Survey, which is based on interviews with over 50,000 passengers who have just made a journey, it appears that the main driver of satisfaction is punctuality while the main driver of dissatisfaction is the way in which rail operators handle delays (which itself is usually related to punctuality),

In 2009 Passenger Focus, as part of a wider piece of work on fares and ticketing[25], carried out some in depth research on the drivers of passenger satisfaction with value for money[26]. This research found that value for money was fundamentally linked to price. For example, among long distance passengers, those holding advance single tickets rated value more highly than those holding full price open tickets. However, in looking at the overall drivers of value for money it was clear that quality factors also play an important part. The three most important factors influencing value for money among both commuters and long distance passengers were:

- Punctuality and reliability
- Being able to get a seat
- Passenger information during service disruption

1.5 The project process

The FP7 project ERRAC Roadmap started on 1st June 2009. Its purpose is to follow through on the ERRAC Strategic Rail Research Agenda [27]. Inevitably the vision for the future railway is not fixed, and as the impact of climate change, energy costs, road congestion and global competition for the railway supply industry are evaluated, the vision and technical strategy are modified.

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[25] *Fares and Ticketing Study*. Passenger Focus 2009

[26] *Fares and Ticketing Study – Appendix A – Understanding Drivers of Satisfaction*. Passenger Focus. 2009

[27] *Op. cit.*

The impact of completed and on-going projects within the EU Framework Programme and national programmes changes the definition of research needs. These factors have been reflected in a recent ERRAC publication, *Rail Route 2050: the sustainable backbone of the Single European Transport Area*. *Rail Route 2050* provides an initial update of the ERRAC vision for railway research and innovation, projecting it to 2050.

As part of the Roadmap process, open workshops have been held on a biannual basis by all work streams to ensure that the widest range of opinions and knowledge sharing are available for inclusion in the developed maps. The process aimed to:

- Define the updated vision for the future railway
- Develop the technology requirements to deliver the vision
- Examine past and current research projects to identify gaps in the research strategy for delivering these technology requirements
- Propose projects to deliver the research agenda in a logical sequence and timescale

The long-term framework for the SRRA sets out seven research priority areas. What follows relate directly to the work of that part of WP02's remit which was concerned with passenger issues, as opposed to freight matters.

1.6 Legislative background

Broadly speaking a distinction can be made between European rail legislation concerned with:

- furthering the creation of a single European railway area,
- legislation that is intended principally to deal with rail market access, and
- rules applying to the relationship between railway undertakings and their passengers.

1.6.1 Furtherance of the Single European Railway Area

The first category is exemplified by the Regulation establishing the European Railway Agency, Regulation (EC) No. 881/2004, as amended by Regulation (EC) No. 1335/2008. There are a number of important related Directives. Directive 2008/57/EC, on the interoperability of the European railway system, lays down the areas in which technical specifications for interoperability (TSIs) must be developed and the process for so doing. In other words it is concerned with enabling the different technical systems used by European railways to work together. Directives 96/48/EC and 2001/16/EC, as amended by Directive 2004/50/EC, are designed to provide for eventual interoperability across the whole of the European rail system.

TSIs have also been developed by the ERA in some directly passenger-related areas. These include the TSI PRM (People with Reduced Mobility) to ensure accessibility of trains and stations, TSI TAP (Telematics Applications for Passengers) to provide passengers with information before and during the journey, reservation and payment systems, luggage

management and management between trains and with other modes of transport. All of these will set up the framework of the European railways for the coming decades.

The work being carried out by the UIC Passenger Forum is important since it is both a source for research topics and a tool for implementing research results into leaflets. Example of relevant leaflets are the UIC leaflet 140 *Eurostations* defining a common framework for station design across Europe to ensure accessibility and UIC leaflet 413 which describes measures to facilitate travel by rail, both of which feed into the TSI PRM.

Directive 2004/49/EC concerns safety and the role of the ERA in ensuring the safety of the European railway system. This is achieved through the creation of common safety methods and targets, monitoring of safety performance and the providing support to the network of national safety authorities. The European Commission has indicated that it intends to introduce additional legislation with the purpose of strengthening the powers of the ERA and advancing moves towards a Single European Railway Area.

1.6.2 Rail market access

The second group comprises principally the legislation known as the 'Railway Packages' – Directives 2001/12-14/EC and Directive 2007/58/EC. These were intended to increase the competiveness of the European rail sector. The 'Railway Packages' are designed to promote development of an effective rail infrastructure, the creation of an open rail market, removal of administrative and technical barriers, and assist in establishing a level playing field with other transport modes. The Third Railway Package introduced open access rights for international rail passenger services including cabotage which allows railway undertakings to pick up and set down passengers at any station on an international route. It also introduced a European train driver's licence allowing train drivers to circulate on the entire European network. The First Railway Package is presently being recast with the intention of reinforcing the institutional environment to promote greater competition, including strengthening supervision by independent rail regulators in each Member State and of the independence and providing for more transparent market access conditions and easier market access for new entrants to the rail market in a member state.

1.6.3 Passengers' rights and service quality standards

The third category of *acquis* concerns passengers' rights and particularly the rules governing the relationship between railway undertakings and their passengers. This is exemplified by Regulation (EC) No. 1371/2007. In effect it transposes into EU law the provisions established by COTIF (the Convention on the International Carriage of Passengers by Rail) of the Uniform Rules concerning the Contract for International Carriage of Passengers and Luggage by Rail (CGT-CIV). These are designed to protect passengers' rights in event of cancellation, delay or loss or injury. The regulation also sets out other obligations including provisions relating to service quality standards. These include obligations on railway undertakings define service quality standards and implement a quality management system to maintain service quality.

The service quality standards must cover:

- Information and tickets,
- Punctuality of services, and general principles to cope with disruption to services,
- Cancellations of services,
- Cleanliness of rolling stock and station facilities (air quality in carriages, hygiene of sanitary facilities[28], etc.),
- Customer satisfaction survey,
- Assistance provided to disabled persons and persons with reduced mobility,
- Complaint handling, refunds and compensation for non-compliance with service quality standards.

Each railway undertaking must monitor its own performance and make the results public each year on its website. The report also has to be published on the website of the European Railway Agency.

1.7 Public opinion and investment

The cost of EU infrastructure development to match the demand for transport has been estimated by the European Commission at over € 1.5 trillion for 2010-2030. Infrastructure investment alone is unlikely to deliver the multifold change in rail's modal share the Transport White Paper foresees as a necessary goal. Funding for European research and innovation will have a crucial part to play in realising the ambition to develop safer, greener and smarter transport systems for Europe that will benefit citizens, respect the environment, and increase the competitiveness of European industries in the global market. The massive modal shift that is anticipated, with rail as the backbone of a sustainable European transport system, will also need the willing support of potential users: just as – in the words of the White Paper - restricting mobility is not an option, so also will the shift to rail depend on ensuring that the rail-travel is perceived as the attractive option – that it becomes the primary mode of choice. That will require a change in both public attitudes and pose a continuing challenge to railway undertakings and they forever hone their consumer understanding: the market won't necessarily accept tomorrow what it is prepared to tolerate today. The step change in service quality that is necessary to secure willing modal shift will come at a price. The extent to which this is met from the public purse will depend on under-pinning political will with public consensus. That consensus itself will depend on a virtuous circle: that there is a willingness to invest to make rail services more attractive because the rail sector has used public investment to demonstrate its innovative ability to provide attractive services that themselves are sufficiently attractive to win further investment.

[28] In some countries this is covered by separate legislation but such provisions frequently vary between Member States.

A number of Megatrends have been identified. The most relevant for the long distance passenger Roadmap include:

- **EU-27 economic growth leads to increased demand of transport**

Continuing economic growth of the European Union and the efforts to integrate countries and regions will increase demand for regional and interregional passenger travel, both for work and for leisure. This growth may be vulnerable to fluctuations in economic activity although the impact of down-turns is likely to be greatest on the freight market. Increasing road and air space congestion in Europe combined with concerns about environmental impacts of personal travel will contribute to de-coupling growth in demand for public transport from changes in GDP.

- **Sustainable development**

The need to align economic development with sustainability will affect the way people travel. However, while the rail sector presently has something of an advantage in terms of greenhouse gas emissions it will need to innovate if it is to retain this advantage in the face of improvements being made by other modes.

- **Impact of demographic changes**

The increase in the proportion of the population represented by older people, combined with improvements in their active life-expectancy and their relative spending power, will influence changes in the mobility requirements of passengers. (By 2050 the median age in Europe will rise by about ten years to 49 years.) These changes will be heightened by an increasing move towards the concentration of population on urban and semi-urban settlements rather than rural dispersal. This could be an advantage for rail (and metro) but the need for intermodal coordination increases. People's average height and body mass index is increasing.

- **Higher presence of women in the work force**

An increase in the proportion of the workforce made up by women can be foreseen. More women will travel to work and more women will expect their own personal transport. The needs of women concerning such things as personal security must be considered and the implications for rail analysed.

- **Customer perception of rail**

The perception that both the public generally and potential passengers specifically have of rail are important factors in attracting new rail users. The European Commission's Rail Market Monitoring Scheme has shown that consumer satisfaction with "Extra urban transport"

(including long distance rail) is very low while ”New motor vehicles” ranks highest among 19 services and goods markets[29]. This highlights the rail sector’s quality problems.

- **Increased competition and liberalisations of the railway market in Europe**

The railway market for passenger services is gradually opening to new entrants. 2010 has seen the opening up for international passenger services (with cabotage) and the EU is contemplating further market opening. Advantages and drawbacks of competition between operators from a customer perspective is an important topic.

- **Cooperation between different modes to facilitate door to door travels**

Rail transport is increasingly used as part of the multimodal transport choice made by passengers to complete their door-to-door journeys. This poses a critical need to deliver a more integrated service including coordination of information delivery and timetables between often competing operators for instance. A clear cooperation framework would be necessary in order to effectively deliver the necessary connectivity in order to achieve a seamless travel experience.

- **Availability of well-functioning nodes for modal transfer**

Interchanges between rail and other modes must be user friendly in order to facilitate connectivity. Signage and other information at stations should be easily accessible, as should travel and ticketing information.

- **Fast adaptation between supply and demand**

Peak hour demand or sudden demand changes should be dealt with in a flexible way. Passengers should not have to stand in train corridors on regional and interregional train services. This should not exclude yield management pricing aimed at more even utilisation of rolling stock and other resources.

- **Accessibility for disabled people and people with reduced mobility**

The railway system should be accessible for all passengers, including disabled people and others with reduced mobility. A set of priorities should be worked out from which it is possible to decide cost effective solutions that can be implemented within reasonable time spans. Passengers may face problems with the sufficiency of timetable and connectional information, support facilities at stations and help with movement from stations into the train. These matters are covered by Regulation (EC) No 1371/2007 and by the TSI-PRM.

[29] COM(2009) 676 and SEC (2009) 1687, Annex 23.

- **Systems for providing traffic information at times of disruption**

Public transport users often have difficulties in getting accurate information on train delays and how it will affect connecting journeys by other modes or Railway Undertakings. The competitiveness of rail would be enhanced by systems that enable passengers to access a comprehensive picture of how their end-to-end journey is likely to be affected by disruption to any part of the journey. A number of FP7 projects are working with this.

- **Harmonised passenger rights**

Harmonised passenger compensation arrangements that are applicable if services are cancelled or delayed and which can function in cross border situations will become more important as European integration progresses. Regulation (EC) No 1371/2007 deals with the rail sector and other Regulations deal with the air traffic sector and, prospectively, with coach and bus and maritime journeys. The PT sector (UITP) has pointed out that having different regulation is not practical for different modes when intermodal trip chains are becoming the norm.

3. State of the art & recent research

3.1 Projects

This chapter provides a summary of EU-funded projects with a distinctive passenger perspective. A total of fourteen projects have been selected as examples, projects that are finished or on-going. Ten out of the fourteen projects had the passenger in focus, with both theoretical and specific tools such as a handbook, open-source, simulation tool, tool-kit best-practice and a prototype as a result. Two projects were about operators and resulted in IT-solutions and software. Two projects had the supply industry as main their main focus and concluded that standardisation was appropriate.

Project	Timeframe (years)	Participation	Content	Results
Selection of European projects concerning passenger train services, as part of a multi-, or co-modal, transport chain.				
Projects in category: Performance				
3.1.1 Fast and comfortable trains[30]	2003-2005 (finished) Project cost: €1 641 339 Project funding: €870 166	Consortium of: EU FP 5, railway infrastructure manager, research institutes, universities, industry partners	To establish comprehensive criteria and provide a simulation tool to maximize performance of tilting trains without people getting nausea, special attention in the project to mixed traffic condition	Three work packages have been completed, giving information on the track layouts and investigations have been made to review how track geometry can be optimized to avoid passengers getting nausea from the performance of trains fitted with a tilt mechanism. A comparison was made of European standards and national limits have been compared. [31].
3.1.2 Public transportation - Accessibility for all[32]	2009-2012 (on-going)	Consortium of: EU FP 7, transport research institutes, universities, industry partners	To develop a prototype of a vehicle based boarding assistance system (for rail vehicle access)	On-going Until now best practice re-commendations for existing vehicle and platform based boarding assistance systems (BAS) has been produced.

[30] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=10099043&pid=41&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

[31] http://www.transport-research.info/Upload/Documents/200607/20060727_144439_87329_FACT_Final_Report.pdf

[32] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=11065734&pid=1&q=B7F482FF429AF6440FA1CC16A9C7610B&type=sim

	Project cost: €2 750 614 Project funding: €1 807 662			The project aims to develop a prototype for a standard boarding assistance system that can be mounted into all types of existing rail vehicles or installed on all types of platforms.[33]
Projects in category: Capacity				
3.1.3 Optimal Networks for Train Integration Management across Europe[34]	2011-2014 (on-going) Project cost: €7 970 833 Project funding: €5 381 969	Consortium of: EU FP 7, transport research institutes, universities, industry partners	To develop new methods and processes. The research's aim is to maximize the available capacity on the European railway network and to decrease overall delay. The project will look at: customer satisfaction, dependability, resilience, and green alternatives and approaches for alleviating congestion at bottlenecks.[35]	On-going
Projects in category: Seamless				

[33] http://www.pubtrans4all.eu

[34] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=12188423&pid=0&q=20631DACB11DC8D7A5C36D74C3A355C1&type=sim

[35] http://www.rsm.nl/research/decision-information-sciences/research/intelligent-demand-and-capacity-management-projects/on-time/

3.1.4 Interconnection between short and long-distance transport networks[36]	2009-2011 (finished) Project cost: €1 947 129 Project funding: €1 491 927	Consortium of: EU FP 7, transport research institutes and universities	To investigate factors such as integration, co-operation and competition in local connections across the different transport modes.	A case study has been done and project deliverables focus on interconnectivity. INTERCONNECT has led to best practice recommendations and they have also widened the research to include testing their applicability and likely performance in representative situations. A new tool has been developed, with the aim of analysing potential solutions for improving interconnectivity. [37]
3.1.5 INtegrated European Signalling System[38]	2008-2012 (finished) Project cost: €15731119 Project Funding: €10015379	Consortium of: EU FP 7, transport research institutes, universities, industry partners	The main focus of INESS is to define and develop specifications for a new type of interlocking systems and apply methods and tools capable of reducing LCC and enhance the standardisation process. INESS have several main goals including to harmonize the functions, architectures, interfaces and connections of the interlocking as a constituent of signal-ling involved in ERTMS	The project has resulted in both quantitative and qualitative results which have been, for example, models for standardisation in the signalling area and more qualitative results which have led cost reduction methods and security analysis related to ERTMS.

[36] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=10720787&pid=18&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

[37] http://www.interconnect-project.eu/

[38] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=10453414&pid=6&q=61D29BB326523973DD9C292966273BF6&type=sim

3.1.6 Seamless Public Urban Rail Transport (SPURT)[39]	2003-2007 (finished) Project cost: €2537452 Project Funding: €1399113	Consortium of: EU FP6, research institutes, universities and industry partners	The SPURT project focused on the development of solutions to the complex situation in the urban rail transport industry, concerning the compatibility and interoperability issues among present or future networks.	New methodologies to prolong the lifetime of materials such as wheels etc. and has increased technical knowledge through analysis of existing material and investigation of how to improve and develop these without increasing overhead costs. Data collection and a 1 year study in Milan that included tramways, wheel studies, speed etc. that aim to optimize the material and minimize the cost.
3.1.7 Transport Intermodality Data sharing and Exchange NeTworks[40]	2000-2003 (finished) Project cost: €3462660 Project Funding: €1477619	Consortium of: EU FP 5 transport research institutes, railway infrastructure managers and industry partners.	Developing specifications and software modules to enable the sharing and exchange of real-time multimodal traffic and traveller information through the whole Transport and Travel Information content chain	Two sets of specifications and software modules were produced to enable the sharing and exchange of real-time multimodal traffic and traveller information through the whole Transport and Travel Information content chain. They were implemented at 4 test sites in Europe and produced the final specifications. All of the applications have proved successful, and continue to operate after the end of the project.

[39] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=7521694&pid=36&q=8079B5D0E362A1658F929D7E7E39F89D&type=sim

[40] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=5102997&pid=59&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

3.1.8 Modular urban guided rail systems[41]	2005-2009 (finished) Project cost: €19086871 Project Funding: €10400000	Consortium of: EU FP 6 transport research institutes, railway infrastructure manager, universities and industry partners.	Designing, developing and testing an innovative and open common core system architecture and its key interfaces (this covers Command Control, energy saving and access subsystems) as well as de-fining and proving validation procedures necessary to deliver the range of inter-changeable modules. Testing the proto-types issued from the different modules in real conditions (Metro de Madrid).	The major result is the 'functional requirement specifications' (FRS) which summarizes the recommended functional and performance requirements for command, control and train management systems for urban rail applications
Projects in category: Satisfaction				
3.1.9 Extending the Quality of Public Transport[42]	2001-2004 (finished) Project cost: €341175 Project Funding: €300000	Consortium of: EU transport research institutes, transport operators, universities and industry partners	Equip is aimed at strengthening the role of local public trans-port operators in im-proving the quality of transport in a self-assessment handbook for benchmarking quality. In the second part of the handbook, the collected indicators are grouped into twelve “clusters”. The last cluster listed safety which provides the	The project's results are mainly addressed to persons responsible for managing benchmarking actions within public passenger transport organizations. Nonetheless, a shorter document on Conclusions and Recommendations has been generated for policy makers and other interested readers. However, the project has focused on performance attributes determined by public transport operators,

[41] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=9840393&pid=60&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

[42] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=3998597&pid=37&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

			indicators of incidents and health and safety.	rather than from the consumer perspective.[43]
3.1.10 Public participation and urban transport innovation. The European light rail renaissance and user involvement, city revitalization, urban mobility agenda.[44]	2010-2012 (on-going) Project cost: €216782 Project Funding: €216782	Consortium of: EU FP 7 Technische Universitat Berlin	The project analyzes the mutual relations between tram revival and the emergence of participative democracy and passenger involvement in public transport. The empirical research is focused on six European cities and thus six case studies to understand how in principle similar problems and tasks were identified and solved in very different ways.	On-going
Other relevant projects				
3.1.11 HERMES	2010-2011 (finished)	Consortium of: Research institutes Universities EU FP 7 Transport	Hermes aims to develop, contribute with knowledge and analyses patterns of	The project has led to a business model for interconnectivity and has improved the knowledge of

[43] http://www.transport-research.info/Upload/Documents/200310/equip.pdf

[44] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=11351786&pid=22&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

	Project costs; €1 838 284		human mobility and the structural and organisational patterns that can be found at the interface between long journeys and shorter local / regional transport. The project focuses primarily on identifying passengers' demands and to see what services are offered to provide the requested service instance through services on mobile phones or the Internet.	the area which is an important part of the project. The use of case studies has been more quantitative which have has delivered the project the estimated results that were planned.
3.1.12 MODTRAIN - Innovative Modular Vehicle Concepts for an Integrated European Railway System[45]	2004-2008 (continued as a new project "MODBRAKE") Project cost: €30310182 Project Funding: €16860000	Consortium of: EU industry partners (including sub-system suppliers), research institutes, railway research centres, universities, transport operators. Many other suppliers and operators are represented via the Association of European Railway Industries (UNIFE) and the International Union of Railways (UIC)	MODTRAIN aimed at the definition and standardisation of the necessary functional, electrical and mechanical interfaces and validation procedures to deliver the range of interchangeable modules, which will form the basis for the next generation on intercity trains and universal locomotives.	The excellent results have led to a new group of European projects, the 'mod-family' projects'. These are projects aimed at promoting the same goals of modularity, interchangeability and interoperability in other transport related areas. The project was run in five sub-projects and these have all contributed to the project is the basis for further one EU-funded project – Modbrake (Innovative Modular Brake Concepts for the Integrated European High-Speed Railway System).

[45] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=7521974&pid=65&q=9B1495CB330CF6A91FBC37270AA50724&type=sim

3.1.13 CROSSRAIL	2000-2001 (finished) Project costs; €1,270,054	Consortium of: Consultants EU	The aim of the Cross-Rail project is to con-tribute to the reduction of the environ-mental impact of traffic by promo-ting more environmentally friendly transport in urban areas, the reduction of road-traffic congestion and the improvement of the quality of city centres.	The result of the study met the main objective, to conduct theoretical studies and identify current state-of-art, not to put new pro-ducts into commercial operation. There are no new legislation and or standardisation based on fin-dings from this re-search project. The objective was only to move forward with "defining" a standard. The project result remains unevaluated.
3.1.14 Gröna tåget (The Green Train)[46]	2005-2011	Consortium of; railway infrastructure manager universities, research institute, industry partners and the Swedish Governmental Agency for Innovation Systems	Green Train is an industry-wide railroad research program that aims to generate knowledge for future high-speed adapted to Swedish/Nordic conditions. Gröna Tåget delivers a collection of ideas, proposals and technical solutions for rail operators, infrastructure managers and industry. It is an open source, which means that it is accessible to all conceivable stakeholders.	An analysis of the travel markets for long-distance passenger traffic shows that high-speed trains will have good prerequisites also in the future, provided that: o Journey times are short and attractive, in particular in the business travel market o Fares are low, in particular in the private travel market o Frequency of service is high, in particular on short and medium-length routes o Good comfort and service can be offered. o It is thus these demands that must apply to a new high-speed train like Gröna tåget

[46] http://www.gronataget.se/upload/PublikaDokument/GronaTaget_eng16p.pdf

4. Targets

4.1 Transport White Paper, 2011

The European Commission's Transport White Paper sets out a number of goals for a transformation of Europe's current transport system. The ones directly relevant to the work of WP02 include:

- By 2050, complete a European High Speed rail network, tripling the length of the existing High Speed rail network by 2030.
- Maintain a dense railway network in all Member States.
- By 2020, establish the framework for a European multimodal transport information and management system
- By 2050 the majority of medium-distance passenger transport should be by rail.
- A fully-functional and EU-wide TEN-T 'core network' by 2030 with a high quality and high capacity 'comprehensive network' by 2050 and corresponding set of information services.
- By 2050, connect all 'core network' airports and to the rail network, preferably High Speed.
- Deployment of European Rail Transport Management System.

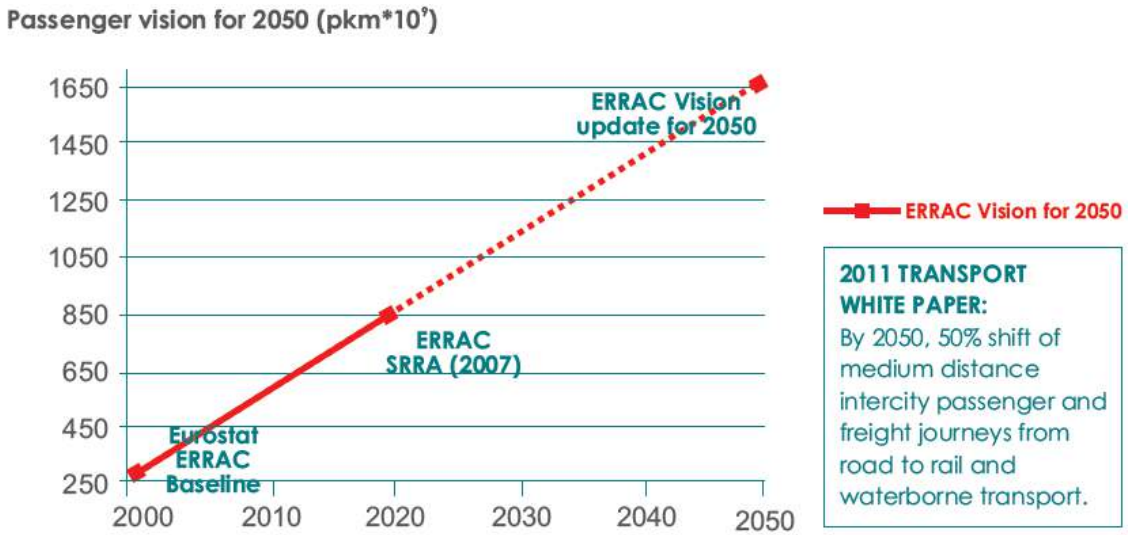
4.2 ERRAC's rail business scenarios

The Description of Work issued in conjunction with this part of the Roadmap project recalled the rail business scenario for 2020 developed by ERRAC and set out in its 2007 revision of ERRAC's *Strategic Rail Research Agenda 2020*. The volume of passenger kilometres would double by this date while freight traffic would triple. Research was seen as central to delivering this scenario.

Rail Route 2050 provides an initial update of the ERRAC vision for railway research and innovation. It notes that its projections are consistent with those of the White Paper. By 2050, there will be a 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport[47]. Overall, it defines the primary target for

[47] See pp. 21-2, *Rail Route 2050: the initial update of the ERRAC Vision for Railway Research and Innovation for the future of rail,* ERRAC, 2011. The Transport White Paper identifies this goal for modal shift from road specifically for freight. For passenger transport it sets the less precise, but no less demanding, target noted above that by 2050 the majority of medium-distance travel should be by rail.

strengthening competitiveness as doubling passenger and triple freight traffic in Europe. It goes on to say that, in order to develop the roadmaps and guide the necessary research, more specific targets must be developed.



4.3 Rail Route 2050 targets

Rail Route 2050 also establishes a number of more specific targets relating to the work on Encouraging Modal Shift and Decongesting Transport Corridors in relation to the passenger sector. These include:

- European citizen receives real time traffic and journey information thanks to improved communication and information systems, allowing better services, including easy re-routing.
- Passengers will enjoy seamless journeys in a safe and secure environment (travels from A to B fully independent of mode).
- Practically all customers will arrive at the destination on time because 95% of all trains are punctual, arriving within 5 minutes of the planned time of arrival.
- Improved system performance and advanced on-board and way-side technology together with full interoperability will deliver reliable, available, maintainable and safe trains; (*New command control technology will contribute to increase the reliability of connections and network capacity*).

- By 2050 rail transport will be the most secure public transport mode without perceiving intrusion to privacy.
- Stations have a new design with low or very low perceived and actual risk, while older stations are upgraded.
- Rail transport is the safest transport mode in Europe.
- Passengers will benefit from new methods of degraded mode management that will significantly minimise disruption and maintain risk at an acceptable level.
- Improved competitiveness with new rolling stock, operational systems and infrastructure that breaks dependency on oil and delivers the maximum economic, quality and capacity benefits for the least environmental impact.
- Going beyond interoperability: by 2050 technological solutions will enable the establishment of a seamless European transport system.
- By 2050 the capacity of a given railway will be doubled compared to today, with improved train operation and management, together with more intelligent and automated train operation. (*Innovative solutions for rolling stock and equipment will reduce the maintenance costs and increase their RAMS.*)
- Analyses on long term projections for passenger and freight travel have allowed an optimisation of the service provided for an increased demand.
- Track access charges are optimised following a transport system LCC and environmental approach.
- Modernisation and take-up of new technology of rail equipment is at least as fast as in other modes.
- By 2050 the European rail network is fully interoperable and regulated in the most viable conditions.
- Rail significantly contributes to local, regional and national economic development. (*The costs and time for the production of new rolling stock and equipment are significantly reduced thanks to new manufacturing processes.*)
- Maintenance cost of infrastructure is reduced by at least 50%. This will have been achieved by the development of cost efficient maintenance and maintenance-free infrastructure systems together with strategies for fewer maintenance interventions, the use of more reliable track systems and the automation of maintenance activities.

- The improvement of station design attracts passengers and interchange is organised not only between the various rail market segments, but also between rail and other modes of transport.

- The infrastructure conditions are improved with lines equipped with innovative technologies and, through research, into the correct revitalisation of older infrastructure. (*New advanced monitoring and diagnostic systems together with the use of innovative solutions guarantee the optimum infrastructure.*

5. Identification of gap themes

5.1 General Framework for Roadmap Scorecard

The Roadmap Philosophy is to identify those things that might impede rail from fulfilling its potential in facilitating sustainable end-to-end travel. This has been done through a gap analysis which is structured in the form of themes in a Scorecard. Milestones have been set (2015, 2020, and 2030) by when the impediments should be resolved. Chapter 7 contains the Roadmap, with arrows indicating the need for research, demonstrations or regulatory framework changes for removing the problems in the Scorecard.
The implementation of the Roadmap will lead to the higher system capacity necessary to accommodate increasing passenger volumes at lower cost, thereby enabling the greening of Europe whilst providing services of a quality that will meet customers' expectations. This also includes managing the connections in a holistic way in order to achieve seamless and easily accessible door to door journeys.

The concept of inter-connectivity has various implications:

- Interconnectivity between modes (eg longer distance rail and metro services; rail-air; rail-bicycle; private rapid transit links using guided unmanned vehicles).
- Interconnectivity between systems (eg ticketing and information systems across all operators, modes and territories).
- Interconnectivity with the particular needs of different types of user (eg Business, Leisure, Commuting, Passengers with Reduced Mobility).
- Interconnectivity with other disciplines (eg Passenger transport planning and spatial planning).

The management of cost and value for money requires basic knowledge about the rail system's cost structure. The development of a high level model of the whole system cost

would facilitate the prioritization of the research needed to meet the societal expectations. These issues are addressed in the report from ERRAC WG V, Strengthening Competitiveness.

5.2 The Framework for this Passenger Roadmap

The Passenger Roadmap reflects the four themes that we have identified as reflecting the passenger priorities that need to be accommodated if there is to be a significant shift in rail's modal share of the passenger market of the nature foreseen by the European Commission's Transport White Paper. The four themes are:

- Improving Performance
- Enhancing Capacity
- Facilitating Seamless End-to-End Journeys
- Increasing Passenger Satisfaction and Perceptions of Value

The Roadmap's topics relate to more than one of these themes in every case.

5.3 The Gaps that are addressed by the Roadmap topic areas:

a. **Integrated information systems handling the whole journey across modes and different mobility providers:** The European Commission's 2011 Transport White Paper foresees the need for multimodal modal shift to rail and other more sustainable means of transport including public transport. This switch is currently inhibited by the problems that many potential passengers have in accessing reliable information about service frequencies and times, prices, facilities, etc. for the whole journey. If the concept of co-modal, sustainable, seamless end-to-end journeys is to be a reality there is a need to address the provision of such information, including real-time information at times of delay and disruption (information provision when things are going wrong with a journey being a prime passenger concern). This presents research challenges both in terms of systems' architecture and to ensure that any system is easy to access from a users' perspective.

b. **Equipping trains to meet passenger expectations:** The life of railway vehicles such as passenger carriages is typically 30-40 years or more in contrast to the automotive sector where a new car may be replaced after within a year or two. Design can soon seem dated as tastes evolve and new social demands emerge. Technical requirements change as society adopts new ways of doing things – wireless telephony, Wi-Fi, personal entertainment systems to take just a few technology-based examples. Social requirements also change as subtle shifts take place in the demographic structure of our society or in social behaviour such as the long-term shift to convenience food from formal dining. We know from research that passengers understandably place attach importance to their ability to travel in reasonable comfort, in reasonably presented

accommodation. If rail is to compete more effectively with other modes in the future it needs to develop a greater understanding of passenger needs and aspirations in this respect, to find ways of planning for the flexible adaptation of passenger vehicles to meet changing demands over their planned service life as well as assessing the trade-offs in whole-life costs of vehicles.

c. **Punctuality and reliability:** Punctual and reliable service provision is by far the most significant driver of passenger satisfaction: there is substantial evidence of a clear correlation between the performance of a service and satisfaction. Achieving modal shift will, to a considerable extent, depend on raising performance levels. The implementation across the Single European Railway Area of ERTMS should make a significant contribution to improving performance while there is considerable scope for the development and implementation of processes and ICT tools to improve time tabling and operational management. The target outcome should be to ensure that practically all customers will arrive at their destination on time because 95% of all trains are punctual, arriving within 5 minutes of the planned time of arrival.

d. Minimising disruption and maintaining risk at an acceptable level through new methods of degraded mode management: The perceived failure of operators to 'manage right when things go wrong' is the principal driver of passenger dissatisfaction. While the development of passenger-accessible real time information access system should ameliorate some of these situations a significant number is likely to be pre-empted by improved systems, methods and technologies for degraded mode management with the additional advantage of contributing to the all-important passenger satisfaction driver of punctuality and service reliability.

e. Securing an optimised trade-off in vehicle design between higher capacity with comfort, functionality and affordability: Continuing research and development is required if the balance between affordability (both in terms of prices to users and the availability of funding) and accommodating growing numbers of passengers in a way which meets their expectations for a comfortable and pleasant journey experience is to be met. As noted above, passengers' needs and aspirations are both varied and constantly changing while the planned working-life of railway equipment is very much longer than that of its road transport competitors. Developing cost-efficient ways of providing for the adaptation of vehicle interiors is a significant design challenge that needs to be faced by both the supply industry and operators.

f. Reducing costs by improving utilisation of track capacity, equipment and skilled staff: There is scope for improved train management systems together with more intelligent and automated train operation. One of the subsidiary challenges is to ensure that this is implemented in a way that doesn't give rise to passenger apprehension about system safety or, if certain staff are redeployed from front-line roles that are presently

visible but potentially redundant, ensuring that vulnerable passengers do not feel less secure on railway premises or on trains.

g. **Increasing speeds and reducing journey time:** It is already planned that there should be a three-fold increase in the size of the European High Speed rail network by 2030, facilitating the modal shift to rail from less sustainable modes for longer journeys. In developing links between the TEN-T network of airports and the High Speed rail network careful consideration needs to be given to the possible trade-off between the cost-penalties on other users of the network by diversion into airport terminals and the advantages of people-mover systems between airport terminals and any High Speed rail route in their vicinity, as at Düsseldorf airport.

h. **Improving station design:** There is evidence from major station improvement schemes throughout Europe that imaginative investment in station design, up-grading or replacement can produce a notable increase in passenger satisfaction, while transforming the attitude of the wider public to the potential of the rail network. Stations cease to be places from which just to join or leave a train but can develop a wider appeal as places to shop, eat and drink and generally enjoy. Perhaps as or more importantly, a good station experience can have the effect of reducing passenger's perceptions of a journey being over-lengthy or tedious. Done right, station improvement can facilitate modal shift to rail. Such changes don't necessarily require new station buildings; much can be achieved with an intelligent approach to improved signage and attending to those features like dark and poorly maintained subways that make passengers feel less secure and providing climate (and vandal) resistant waiting areas.

i. **Seamless door-to-door journeys:** The goal of enabling seamless travel that may involve a number of modes or a variety of operators depends on resolving a number of issues. Prospective passengers need ready access to a source of information on their journey options and the likely costs of different variations if they are to exercise their rights effectively as 'informed consumers'. They need to be able to obtain and make payment for whatever tickets may be required – preferably through a single integrated, smart transaction if this best suits their needs and doesn't compromise the passenger rights. (The commercial and technical barriers to inter-compatibility of different systems have been successfully overcome in mobile telephony: a similar degree of seamless system integration is required for public transport – between operators, modes and territories.) Interchanges between modes or the services of different operators should be seamless, well-designed and well-sign-posted while connections should be reliable and alternatives guaranteed should anything have gone wrong with the planned preceding leg. Mobility needs management as well as the application of common standards that passengers can rely on.

j. **Mobility for all:** There is still some ambiguity about the extent to which our society is committed to the principle of mobility for all with the elimination of any form of discrimination against passengers with reduced mobility. Yet the issue is crucial: if the needs of PRMs are being met we can be satisfied that the needs of the wider travelling public are also being accommodated. This is implicit in coping with the needs of an aging population: the Single European Railway Area must not be allowed to be out of bounds.

k. **Rail and land use:** There are areas where rail, historically, has blighted land use. Dirt from steam trains, noise from brakes, dereliction as parts of the railway estate are rendered obsolescent and left in decay, communities separated on different sides of the track, hubs that are more self-evidently a magnet for sleaze than for the discerning passenger. But there is also a great deal of recent development that shows what can be achieved and the substantial value added to areas where modernised rail has been used to drive regeneration and intelligently conceived development. Our society needs to get better at exploiting rail's potentially beneficial contribution to land use planning, in linking communities with employment, recreation, education and access to services, in delivering large flows between two points, in enabling higher density urban development and avoiding the despoliation of urban centres as well as residential areas with traffic congestion and parking lots. Policy makers and spatial planners need the tools to understand the potential of rail, to appraise this consistently with appraisal of other modes and to prepare our society as it prepares for the world after both 'peak oil' and 'peak car'.

l. **Measuring satisfaction:** Improved satisfaction is a good outcome for any policy initiative. Passenger satisfaction is a good measure of the work of those responsible for planning and delivering activities right across the rail sector. The providers of train services presently rub shoulders with investment and pensions' providers, real estate agents, banks and second-hand car salesmen at the bottom of the European Commission's annual Consumer Markets' Scoreboard. It should aim to deliver services that lead its end users to rate it in the top quartile of service providers – alongside those services who presently air carrier, packaged travel and tour operators, new cars and personal care.

5.4 Prioritisation

Experts participated in special roadmap workshops in March 2010, April 2011 and March 2012 to help identify the key gap themes. (The 2012 workshop was held jointly with participants in the ERRAC WG IV concerned with strengthening competitiveness.)

In spring 2010 questionnaires was circulated to a number of people representing operators, passenger organisations and academia from Denmark, Germany, Finland, France, Poland,

Spain, UK and Sweden. Respondents were asked to rank 8 questions by importance on an ascending scale 1 to 5 covering:

- importance of better value for money
- better knowing customer needs (Reliable service performance to satisfy identified customer needs)
- simpler and easier ticketing using electronic devices
- better passenger information especially in managing disruptions
- timetabling that better caters to demand (frequency, less changes between different trains and waiting times between trains at stations)
- more affordable rolling stock
- travel time reductions
- closing high speed gaps

While the views reflected by the responses may lack a scientific basis, one can have some confidence that, when taken together with the advice of the experts involved in the road-mapping exercises, the results to a large extent reflect the discussions and priorities that these experts have in their respective networks. They show that, in serving customer needs better, priority is given to:

- Passenger information systems,
- Reliable service performance to satisfy identified customer needs and
- Customer friendly ticketing and time tabling.

The roadmap deliberations established that, from a European perspective, accurate information regarding service offerings including prices and orientation in stations, platforms and on board trains, including information that allows travellers to manage disruptions, are one of the three most important groups of problems to address. Knowing customers' needs is important for putting together a product that caters to the individual passengers or segments. This includes things like prices, comfort factors at stations and on trains, time table scheduling, journey times and easy and simple ticketing systems which we ranked together with timetabling at number three. These are constituent parts of what gives the rail customer value for money.

The other items; cheaper rolling stock, travel time reductions and closing high speed gaps had lower average ratings and somewhat wider spread around the mean which reflect less consensus among the respondents. One should nevertheless keep in mind that in some relations shorter journey times is an issue which makes rail attractive compared to other modes. Cheaper rolling stock should be an issue for operators since the capital investment of rolling stock is a major profitability factor. Lower capital costs means money for business development, lower ticket prices and creates margins for faster fleet renewal. Likewise is closing of high speed gaps an issue that may be of major importance for some countries but less so for other countries which already have an extensive high speed networks.

6. Vision

The rail sector welcomes the challenge set by the Transport White Paper: the expectation of multi-fold increase in rail's present share of the market for longer distance is an unprecedented opportunity. It is an expression of confidence in the potential of rail as the most sustainable of all modes passenger transport modes in contributing to economic growth and social cohesion. Achieving the major share of this market will require the sector to provide services that are even more attractive than the best of those that it can provide today.

The sector's future depends on securing the necessary enabling investment and on its capacity for relevant research and innovation. Anticipating and understanding evolving consumer needs is crucial to this process.

We have already seen that there are some key drivers that shape passengers' attitudes to rail services:

- Performance
- Capacity
- Seamless end-to-end journeys
- Satisfaction and perceptions of value

These can be illustrated by the following targets which provide an indication of the likely research priorities to under-pin the development of the passenger sector:

6.1 Performance:

- Passengers will enjoy seamless journeys in a safe and secure environment
- Practically all customers will arrive at the destination on time because 95% of all trains are punctual, arriving within 5 minutes of the planned time of arrival.
- Passengers will benefit from new methods of degraded mode management that will significantly minimise disruption and maintain risk at an acceptable level.

6.2 Capacity:

- Passenger vehicle design will seek to optimise higher capacity with comfort, functionality and affordability.
- Improved train management systems, together with more intelligent and automated train operation will deliver higher capacity utilisation of track and vehicles.

- There will be an increased number of dedicated high speed lines while higher speeds will also be achieved on conventional routes.

6.3 Seamless end-to-end journeys

- The improvement of station design attracts passengers, encouraging people to feel that their total journey time is optimised, and the architecture of interchange simplifies inter-connection not only between the various rail market segments but also between rail and other modes of transport.

- European citizen can obtain inter-available, through ticketing across modes and receives real time traffic and journey information thanks to improved communication and information systems, allowing better services, including easy re-routing.

- Design throughout the Single European Railway Area will be inclusive of the needs of passengers with reduced mobility.

- Rail will be used in spatial planning to minimise land-take and to create a more attractive environment.

6.4 Satisfaction and perceptions of value

- The rail sector will deliver long-distance transport services at internalised costs that are consistently competitive with those of other modes.

- Providers of rail services will be rated along with those other consumer services in the top quartile of the European Commission's annual consumer scoreboard.

7. Scorecard and Roadmap

The roadmap work consists of a scorecard where items that need to be addressed have been identified in a consultation process, se section 1.5, if rail is to better serve customer needs and capture higher market shares. The research implications, following tables with arrows, of the scorecard has been analysed by EURNEX[48] .

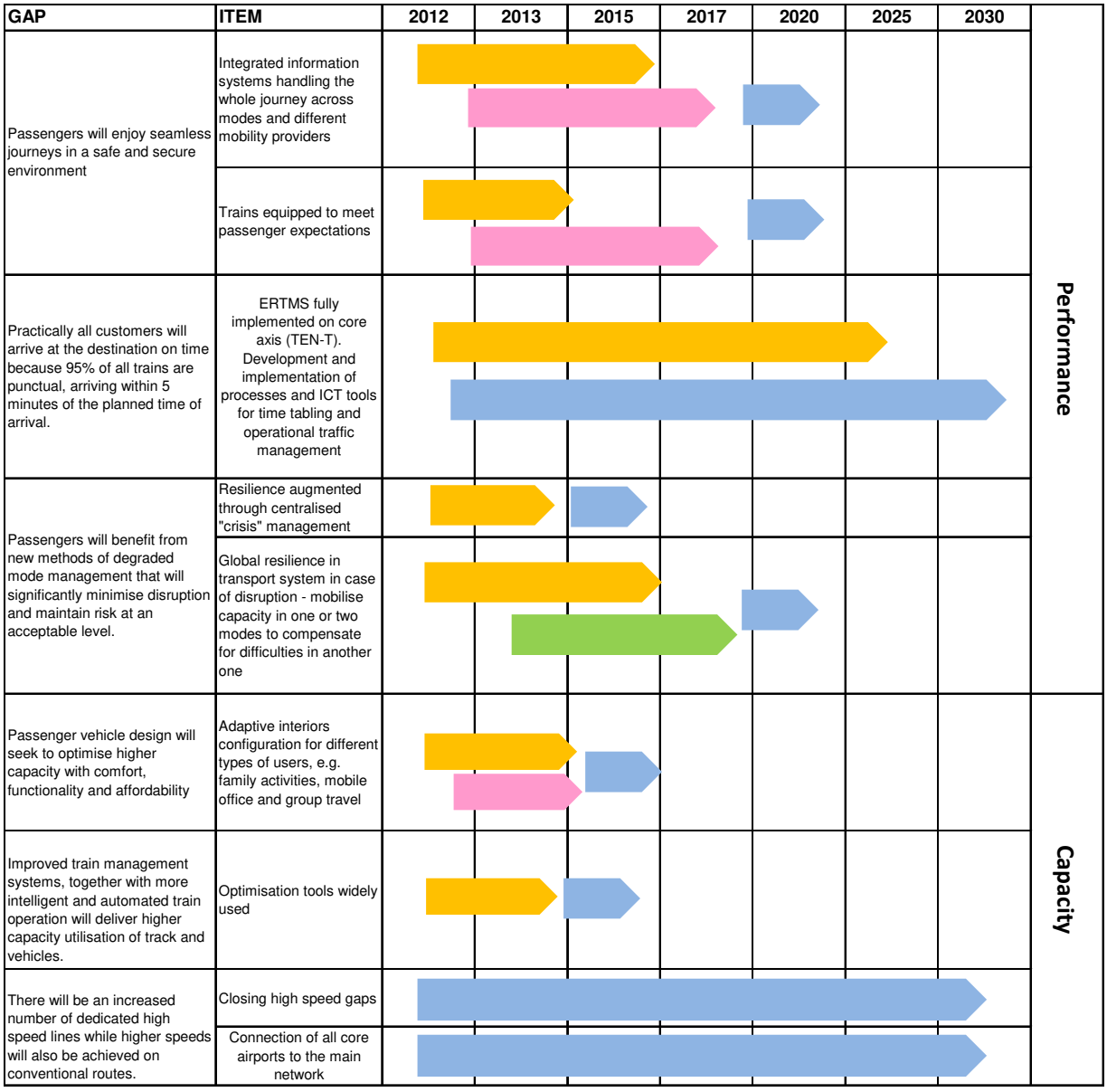
Scorecard

<table>
<tr><th rowspan="2">GAPS</th><th>Milestone 1</th><th>Milestone 2</th><th>Milestone 3</th><th rowspan="2"></th></tr>
<tr><th>2015</th><th>2020</th><th>2030</th></tr>
<tr><td>Passengers will enjoy seamless journeys in a safe and secure environment</td><td>Integrated information systems handling the whole journey across modes and different mobility providers</td><td>Trains equipped to meet passenger expectations</td><td></td><td rowspan="4">Performance</td></tr>
<tr><td>Practically all customers will arrive at the destination on time because 95% of all trains are punctual, arriving within 5 minutes of the planned time of arrival.</td><td colspan="3">ERTMS fully implemented on core axis (TEN-T). Development and implementation of processes and ICT tools for time tabling and operational traffic management</td></tr>
<tr><td rowspan="2">Passengers will benefit from new methods of degraded mode management that will significantly minimise disruption and maintain risk at an acceptable level.</td><td></td><td>Resilience augmented through centralised "crisis" management</td><td></td></tr>
<tr><td></td><td>Global resilience in transport system in case of disruption - mobilise capacity in one or two modes to compensate for difficulties in another one</td><td></td></tr>
<tr><td>Passenger vehicle design will seek to optimise higher capacity with comfort, functionality and affordability</td><td></td><td>Adaptive interiors configuration for different types of users, e.g. family activities, mobile office and group travel</td><td></td><td rowspan="4">Capacity</td></tr>
<tr><td>Improved train management systems, together with more intelligent and automated train operation will deliver higher capacity utilisation of track and vehicles.</td><td></td><td>Optimisation tools widely used</td><td></td></tr>
<tr><td rowspan="2">There will be an increased number of dedicated high speed lines while higher speeds will also be achieved on conventional routes.</td><td colspan="3">Closing High Speed gaps</td></tr>
<tr><td></td><td></td><td>Connection of all core airports to the main network</td></tr>
</table>

[48] European Rail Research Network of Excellence. EURNEX involves more than 600 researchers from over 60 rail research institutes across Europe.

GAPS	Milestone 1 2015	Milestone 2 2020	Milestone 3 2030	
The improvement of station design attracts passengers, encouraging people to feel that their total journey time is optimised, and the architecture of interchange simplifies inter-connection not only between the various rail market segments but also between rail and other modes of transport.	Logical station layouts. Good signage. Locational maps and information on onward local ground transportation options	Comfortable waiting areas. Research, understand and, where feasible, accommodate passengers' varying priorities at different hubs		**Seamless end to end journeys**
European citizen can obtain inter-available, through ticketing across modes and receives real time traffic and journey information thanks to improved communication and information systems, allowing better services, including easy re-routing.		Ticketless journeys (EU level) compatible with local transport fare management systems ; Standardisation of ticketing procedure and ticket information		
Design throughout the Single European Railway Area will be inclusive of the needs of passengers with reduced mobility.			Mobility for all	
Rail will be used in spatial planning to minimise land-take and to create a more attractive environment.	Land use and spatial planning around sustainable efficiences of public transport; 60-80% of energy used to operate train is from renewable sources; develop common appraisal methods for cost benefit analysis of cross border business	Improving the spatial appeal to passengers of the urban environments in which transport hubs are located		
The rail sector will deliver long-distance transport services at internalised costs that are consistently competitive with those of other modes.	Development of tools for policy makers			**Satisfaction and perception of value**
Providers of rail services will be rated along with those other consumer services in the top quartile of the European Commission's annual consumer scoreboard.	Development and implementation of appropriate performance regimes for mobility providers and infrastructure managers			

Flow chart with research implications of the items identified in the scorecard – yellow arrow stands for R&D, rose for demonstrations and prototypes, green for changes in regulatory framework and blue for market introduction



GAP	ITEM	2012	2013	2015	2017	2020	2025	2030	
The improvement of station design attracts passengers, encouraging people to feel that their total journey time is optimised, and the architecture of interchange simplifies inter-connection not only between the various rail market segments but also between rail and other modes of transport.	Logical station layouts. Good signage. Locational maps and information on onward local ground transportation options								Seamless end to end journeys
	Comfortable waiting areas. Research, understand and, where feasible, accommodate passengers' varying priorities at different hubs								
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	Improving the spatial appeal to passengers of the urban environments in which transport hubs are located								
The rail sector will deliver long-distance transport services at internalised costs that are consistently competitive with those of other modes.	Development of tools for policy makers								Satisfaction and perception of value
Providers of rail services will be rated along with those other consumer services in the top quartile of the European Commission's annual consumer scoreboard.	Development and implementation of appropriate performance regimes for mobility providers and infrastructure managers								

Annexe: State of the Art&Recent Research: further details

This Annex details the research tabulated in Section 3 which summarises a selection of European projects concerning passenger train services, as part of a multi-, or co-modal, transport chain. *(Numbering relates to the numbering used in the table that forms the main part of section 3.)*

3.1.1 Fast and comfortable trains

Fast and Comfortable Trains addresses the issue of track layout in the EU 5th Framework Programme. One part of the research is concerned with tilting train technology as a factor for reducing railway journey time. A second aspect of the research concerns the tendency of tilting trains to make some passengers feel nauseous. This is because the effectiveness of investment in new lines could be compromised by concerns about comfort and nausea.

The project searched for common criteria for nausea constraints and integrated it with the comfort criteria to get a solution that would be applicable to not just one country, but on an international level. The project also looked at the economic perspective of track and coach design. The research result should existing lines to deliver shorter journey times.

3.1.2 Public transportation - Accessibility for all

Accessibility in this project focuses on creating an impartial, effective and efficient transport system and in relation to passengers of reduced mobility. *P*roject partners are drawn from several eastern European countries.

The project has 3 main goals;

- To make recommendations for best-practice. Existing boarding assistance systems (BAS) are, for example, either vehicle-based or platform-based ramps or lifts.
- To inform the public and decision-makers about the importance and challenges in providing accessibility for all. There is also of importance to spread the message that reduced mobility is more than just for people needing wheelchairs. People with reduced mobility that would be helped with a BAS are for example children, people with heavy luggage, pregnant, elderly and so on.
- To develop a standard BAS that is suitable for retrofitting into all types of existing rail vehicle or installed on all types of platform. One of the project requirements is that the BAS should be compatible with UIC-wagons.

3.1.3 Optimal Networks for Train Integration Management across Europe

Optimal Networks for Train Integration Management across Europe is part of the EU funded FP7 programme. The project aim is to develop new methods and processes that can be used on the European railway system. Reduced delays and greater traffic fluidity it would help to maximize available capacity. It places emphasis is on resolving congestion at bottlenecks.

Case studies on European corridors, long distance main-line networks and urban commuter railways will be done, with focus both on passenger and freight service. The project will also review best-practice and spread it through organizations such as Rail Net Europe, UIC and UNIFE.[49] Previous research in this field-area has mainly focused on timetable planning and real-time traffic management for railways.

3.1.4 Interconnection between short and long-distance transport networks

This project is within the framework of FP7, *Interconnection between short and long-distance transport networks.* The consortium consists of seven partners from UK, Germany, Denmark, Poland, Spain and Italy. The research is limited to journeys of at least 100 km that contains one or more "short distance feeder". The different scale of networks (local and regional) as well as the difference between transport modes results in a need for co-operation among a range of transport authorities. The interconnection is based on providing an integrated network and attractive services to potential users. One obstacle is that different transport modes sometimes conflict with the larger picture of an interconnected journey because of local priorities and policies. EU and national policies can also have an impact on the different transport modes. Interconnectivity is of great importance and a key factor for integration of the TEN-T network.

By testing the best-practice identified through literature reviews and interviews with stakeholders INTERCONNECT contributes to a wider distribution of best-practice in the field-area. The tool-kit describes the problems and solutions in a matrix with feasibility, applicability and potential impact in focus. It presents a list of 94 possible solutions to identified problems in the categories:

[49] http://www.rsm.nl/research/decision-information-sciences/research/intelligent-demand-and-capacity-management-projects/on-time/

- Local link infrastructure
- Local transport services
- Improvements at the interchange point,
- Check-in and luggage transfer,
- Ticketing and pricing,
- Marketing, information and sales,
- Enabling solutions[50]

This work has since been developed further in new projects launched by the European Commission, with almost the same consortium as in INTERCONNECT.

3.1.5 INtegrated European signalling system (INESS)

The main focus of INESS is to define and develop specifications for a new type of interlocking systems and apply methods and tools capable of reducing LCC and enhance the standardisation process. In the context of current European policies, it is expected to foster migrations of signalling equipment and support the rollout of ERTMS. The European Commission and the European Railway Agency, together with the Railway Supply Industry, are working closely together to define the efficient migration strategy for ERTMS. INESS has several main goals including harmonising the functions, architectures, interfaces and connections of the interlocking as a constituent of signalling involved in ERTMS. INESS will therefore support the development of a new generation of interlocking systems with optimal unified conception and interfaces, in particular those connecting to the ETCS.

INESS is a big project with 30 partners and consists of more than 100 sub-categories. The project has had both quantitative and qualitative results which have been, for example, models for standardisation in the signalling area and more qualitative results which have led cost reduction methods and security analysis. The results will be both useful and necessary in the future ERTMS-projects, for example corridor B, which can draw on the results from this project. Not all the results of these have yet been fully analysed.

3.1.6 Seamless Public Urban Rail Transport (SPURT)

The SPURT project focused on the developing solutions to the complexity of the urban rail transport industry concerning compatibility and interoperability issues among present or future networks. Rail mass transit vehicles, defined as 'trams, light rail and metros', often do not behave as expected when running on the existing infrastructure, despite being fully compatible with the specifications of the buying authorities and even having passed the

[50] http://www.interconnect-project.eu/images/stories/deliverables/ic_d3_1_final_v1.1.pdf

acceptance tests. A major challenge therefore was that a particular vehicle might perform well in one particular network and the same vehicle could show significant problems in another network. Many operators have different types of vehicles and different types of track systems in their network. They all want the different existing and future vehicles to perform well in their complete existing and future network. This is one of the reasons why most vehicles are built to local specifications, continuing the incompatibility and interoperability issues which make it impossible to manufacture vehicles in bigger series at a lower cost.

The results from SPURT are qualitative in the case of new methodologies to prolong the lifetime of materials such as wheels etc. and have increased the technical knowledge through analysis of existing material and investigate how to improve and develop these without increasing the overhead costs.

Quantitatively speaking the project resulted in data collection and a 1 year study in Milan that included tramways, wheel studies, speed etc. that aim to optimize the material and minimize the cost. The results are used by the EU and some countries, for example Germany, are seeking to harmonize their light-rail systems signalling to achieve cost reductions and increase interoperability.

3.1.7 Transport Intermodality Data sharing and Exchange NeTworks (TRIDENT)

TRIDENT is a 5th Framework Program EU project which helps improve the availability and quality of information about private transport and public transport services in Europe. The general objective of the project is enhancing mobility by improving the information system which shows transport situations and facilities to the interested parties (passengers, operators, etc.). During the project certain specifications and standards have been developed for sharing and exchanging transport data in two approaches: the existing EDI approach and the newly introduced object-oriented approach. The approaches were implemented and tested in four European urban areas: West Yorkshire, Rome, Paris and Flanders.

In Flanders and Rome systems were implemented to support a service for door to door travel advice on request for both private and public transport, connecting databases of different transport mode operators. The objective of the Paris site is to provide a tool to capture and disseminate information concerning real time event and the corresponding status on the public transport network. In West Yorkshire the systems are capable of providing real time information for multi-modal journeys involving both bus and train enabling a better informed passenger travel choices. The West Yorkshire and Paris applications are already building on the original demonstration sites to other areas and transportation modes. Flanders is used for assessing supply of public transport in altered demand situations and Rome is considering adding tourism information to the existing TRIDENT application.

The Object-oriented solution has seen a substantial experimental and even commercial take-up during the lifespan of the project as well as afterwards. As a singular commercial solution does not exist for TRIDENT, but it is more a "building block" for future commercial products, no actual figures can be given on the financial viability of the solution.

3.1.8 Modular urban guided rail systems (MODURBAN)

The *Modular Urban Guided Rail System* project was started to increase interoperability in urban transport. It brought together all the major rail industry systems' integrators and suppliers, European urban rail operators and universities in a consortium with 39 members. The project was divided into six sub-projects:

- Mod-Onboard, dealing with onboard subsystems, led by Alstom Transport;
- Mod-Wayside, looking at wayside subsystems, led by Ansaldo STS;
- Mod-Comm, examining the data communication subsystem, led by Thales RSS;
- Mod-Access, focusing on passenger and access related subsystems, led by Knorr-Bremse;
- Mod-Energy to assess energy savings-related subsystems, led by Siemens;
- Mod-System, which adopted a complete system approach for functional and technical specifications and global risk assessment, led by RATP.

The major result "functional requirement specifications" (FRS) includes a complete set of functions and requirements which covers functions for train operation, including rules to ensure safe movement of trains, functions for operation management and supervision, as well as system performance criteria, for example those related to passenger exchange (boarding and alighting at stations). This assures a comprehensive set of requirements, derived from the wealth of experience gained by major players, which represents a state-of-the-art performance specification with no surprises.

The main advantage of MODURBAN's common system architecture is that it is applicable to all system configurations with or without existing interlocking, with or without secondary train detection and it is capable of accommodating different levels of automation.

MODURBAN also defines of a commonly agreed "fault tolerant data communication system" which is transparent to the train control system (previous systems couldn't talk to each other).

"Intelligent driving" dealt with the problems of variation in train parameters with time, and the deviation of the train parameters (such as braking and traction capacities and reaction times) outside the normal range, across an entire fleet.

MODURBAN made an overview of this equipment and functions of the passenger information systems, together with a comparison of the principal European products. It has also defined Passenger Information System interfaces to other MODURBAN subsystems, and provided a useful overview of regulations in the EU member states in the field of video surveillance, as well as a functional description of the system architecture.

Also a number of energy saving models have been reviewed and validated against real-life data. One specific result has been the development of a prototype lightweight interior grab rail.

The MODURBAN train was tested on Metro de Madrid Line 9, on 16 and 17 December 2008. It demonstrated successfully:

- the 'intelligent driving' concept;
- operation of the interchangeable data communication system;
- onboard and wayside equipment for passenger information and video systems;
- the use of lightweight materials, notably the new grab rails.

3.1.9 Extending the Quality of Public Transport

The Extending the Quality of Public Transport (EQUIP) project, has taken place in the Transport Research Programme of DG TREN in the Fourth Framework Programme of the European Commission. The objective of EQUIP was to develop and test a toolbox in the form of a Handbook for the self-assessment of the internal quality performance of local public transport operators and to ensure, by means of awareness raising activities and liaison activities, that potential users of such as Handbook are aware of its existence.

EQUIP identified a number of necessary conditions for reaching the goal of institutionalisation. The Handbook must be;

- available in the relevant national language.
- managed so that the database up to date
- carried out by a manager who must not benefit from having access to the data.

Finally, responsibility for the benchmarking exercise must lie with the operators, who need to bear the responsibility for the cost of improvements.

The EQUIP project has played an important role in providing public transport organisations with relevant, measurable and comparable indicators for benchmarking, in line with the EU Commission's recommended actions to improve public transport systems ('Developing the Citizens' Network', COM(98) 431 final).The result after project completion is that a network

consisting of nearly one hundred members formed whose role is to promote to EQUIP Handbook should be used.

3.1.10 Public participation and urban transport innovation: The European light rail renaissance and user involvement, city revitalization, urban mobility agenda.

The idea of the project is to see how do the social evolutions in Europe, such as new social movements, new forms of direct deliberative democracy, new emphasis for urban space and culture and reawakening of tram and other above ground urban rail traffic systems influence each other. This project emphasizes the importance of mobility research and it helps understanding urban layout and the role of transport infrastructure.

The project is based on comparative empirical research and focusses on six European cities. These six case studies help to understand how similar problems and tasks were identified and solved in very different ways. Methods which are used in the project are from historiography and political theory in a comparative approach and in combination with participation theory, governance issues, the idea of Large Technical Systems and town planning.

3.1.11 HERMES

Hermes aims to develop, contribute with knowledge and analyze patterns of human mobility and the structural and organizational patterns that can be found at the interface between long journeys and shorter local / regional transport.

The project focuses primarily on identifying passengers' demands and to see what services are offered to provide the requested service instance through services on mobile phones or the Internet. The project also studied the possible solutions in selected areas such as Arlanda airport where changing from air to rail / bus is made. Other studied areas include Lerida and Zaragoza in Spain where there is a change between bus and high-speed trains and the airport in Antwerp where it is traveling between the airport to train / bus.

The project intends to come up with proposals to address and how to improve passenger exchange between long journeys and shorter / regional transport but also the legal, organizational, technical barriers that exist and which also must be studied and resolved to increase exchanges between long distance transport for short / regional transport.

The results from HERMES are both quantitative and qualitative in the aspect that the project has led to a business model for interconnectivity and has improved the knowledge of the area which is an important quantitative aspect. Since an important task for the project was to develop a business model for the area of Cross-modal transport, the main focus has been

qualitative. The use of case studies has been more quantitative which have has given the project the estimated results that were planned. The results from the HERMES project have also led to a handbook which focus on the business model for Cross-modal transport which can give both cities and government knowledge and suggestions how to think and do to further develop this in their cities and countries. The ownership of project results and other administrative things was made up from the start within the project group and with the financing partners and was never any problem. The results are owned by the FP7 but can be used by the project partners in non-commercial purpose.

3.1.12 MODTRAIN

MODTRAIN stands for Innovative Modular Vehicle Concepts for an Integrated European Railway System. It is the first of its kind in the area of joint European railway research. MODTRAIN objectives included increased productivity of rolling stock, reduction of the manufacturing costs as well as time-to-market, increased reliability and lower maintenance costs. MODTRAIN aimed at the definition and standardisation of the necessary functional, electrical and mechanical interfaces and validation procedures to deliver the range of interchangeable modules, which will form the basis for the next generation on intercity trains and universal locomotives.

The MODTRAIN project is a prime example of what can be achieved when Europeans work together. The excellent results have led to a new group of European projects, the 'mod-family projects'. These aim to promote the same goals of modularity, interchangeability and interoperability in other transport related areas.

The project's economic advantages together with the technical solutions fulfill the objectives of increased railway competitiveness and interoperability defined in the agenda for the European Rail Research Advisory Council (ERRAC) and in the First and Second Railway Packages enacted by European Union legislation. A very important development that went beyond initial expectations was the creation of new working relationships between academia, the rail industry and operators.

The project is the basis for further EU-funded project – MODBRAKE (Innovative Modular Brake Concepts for the Integrated European High-Speed Railway System). MODBRAKE aims at contributing to the practical implementation of interoperability of railway systems across Europe by addressing brake system performance.

3.1.13 CROSSRAIL

The CROSSRAIL project is funded by the European Commission under the 5th Framework Programme GROWTH, DG TREN, Sub-programme Area: 'Modal and intermodal transport management systems'. In European cities there is a great potential for improving public transport in the urban areas by integrating tram/light rail systems with conventional rail. A vehicle suitable both for tram operation and for conventional rail has to be developed and the corresponding operation rules have to be set up. Only a European standard can secure a potential big market for the vehicles, resulting in substantially reduced unit cost. The aim of the CrossRail project is to contribute to the reduction of the environmental impact of traffic by promoting more environmentally friendly transport in urban areas, the reduction of road traffic congestion and the improvement of the quality of city centres.

The result of the study met the main objective, to conduct theoretical studies and identify current state-of-art, not to put new products into commercial operation. There is no new legislation and standardisation based on findings from this research project. The objective was to move forward with “defining” a standard.

3.1.14 Gröna tåget (The Green Train)

Gröna Tåget is an industry-wide railway research program that aims to generate knowledge for future high-speed adapted to Swedish/Nordic conditions. It delivers a collection of ideas, proposals and technical solutions for rail operators, infrastructure managers and industry. It is an open source, which means that it is accessible to all conceivable stakeholders.

The purpose of the research and development program is to define an attractive, efficient and economic high-speed train concept based on passengers’ valuations and technical possibilities. Increased train travel on the expense of car driving and air travel is important green quality; even lower energy consumption than present high-speed trains another. Gröna Tåget is unique as it brings together both institutes of higher education, infrastructure managers , railway companies and train manufacturers in a common program.

Gröna Tåget will make it more attractive to travel by train through:

- Shorter travelling times
- Lower costs, enabling cheaper fares
- An attractive, functional passenger environment with a high level of comfort for all.
- To build up knowledge and resources to develop and specify the next generation of high speed trains for Nordic operation.
- Manage the Regina 9062 as a test train for key technologies for Gröna Tåget and Bombardier’s ECO4 concept.
- Promote technology carry-overs to new applications.
- Promote strategy and product definition for next generation High Speed and Very High Speed trains for Sweden.

- Communicate results and findings.
- Attractive design

One of the major objectives of the Gröna Tåget program is to propose technologies and concepts for even better environmental performance, thus maintaining the advantage of rail transportation in relation to other modes.

An important objective of Gröna Tåget is to produce a standard train which is flexible and able to perform a variety of tasks. Gröna Tåget is focused on the future of passenger trains for speeds of 250km / h and above. The project is led by a vision of the Swedish rail research will play a leading role in Europe and contribute to the development of new vehicle solutions and standards. Gröna Tåget will also be an inspiration and source of knowledge for railway companies and vehicle manufacturers in the development of future trains and traffic concept.