NETWORKS

Networking Europe: Vision 2030 and Strategic Research Agenda

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Focus Area Networks

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European Construction Technology Platform (ECTP)
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PREFACE: EUROPEAN TECHNOLOGY PLATFORMS, A NEW INSTRUMENT OF THE EUROPEAN COMMISSION

Research and technological development are thought to be essential in increasing the European competitiveness, economic and sustainable growth and employment. Europe has a long standing tradition of excellence in research and innovation, and European teams continue to lead progress in many fields of science and technology.

However, it is felt that the research is scattered across the continent and all too often their efforts fail to add up in the absence of adequate networking and cooperation. The Commission therefore searches to establish the so called European Research Area (ERA), aimed at a better coordination of research and innovation activities and policies, both at national and EU levels, sharing objectives, expertise and resources.

There is in fact a need of defining the research needs (RTD priorities, timeframes and budgets) on a number of strategically relevant issues and to implement these results in practice overcoming all possible obstacles. (Eurab 04.010 final)

To this aim, the European Commission supports the setting up of the so called European Technology Platform. They should be a major pan-European, mission oriented initiative aimed at strengthening Europe capacity to organise and to deliver innovation strengthening the European wide innovation process.

This means that the Platform should bring together all relevant stakeholders to identify the innovation challenge, develop the necessary research programme and implement the results (Regulatory bodies, government bodies, industry, etc, at both national and European level) or otherwise told platforms should unite stakeholders around a common vision and approach for the development of the technologies concerned, with specific focus on the definition of a strategic research agenda and the mobilisation of the necessary critical mass of research and innovation effort (Comm, 2004, 29 final).

THE EUROPEAN TECHNOLOGY PLATFORM FOR CONSTRUCTION

The construction sector is strategically important in Europe, as it provides the buildings and the infrastructure upon which citizens rely, both for their work and for their leisure. Moreover, the construction sector employs more people that any other industrial sector.

A number of challenges are facing the sector in the next years such as climate changes and sustainability, competitiveness, technology take-up, in service performance, re-industrialisation etc.

The scope or mission of the Platform is therefore to “take the Construction sector to a new high level, by identifying and analysing the major challenges that the sector faces in terms of society, sustainability, technology and by developing strategies for how to address these challenges in the coming decades in order to fit societal needs”

The expected outputs for the Platform may be identified in:

- Developing a vision for the European Construction Sector by 2030
- Defining a Strategic Research Agenda, SRA, for how to reach this vision, including roadmaps and strategies for a range of focus areas
- Favouring increased industrial participation in R&D investment
- Defining priorities for further improved return on investment on public R&D funding, especially the European Commission 7th Framework Programme
- Contributing to the European Research Area, ERA, including integration of Member State research programmes and projects
- Contributing to the integration of New Member States
- Recommendations regarding EU and national legislation and regulation to create incentives for growth and development.

These outputs may be reached by mobilising the necessary critical mass of research and innovation effort.
1 FOCUS AREA ON NETWORKS

1.1 BACKGROUND AND PRESENT POSITION

Within the Platform a specific Focus Area is dedicated to the Networks of infrastructure as they represent the largest part of the built environment. Networks are the fundamental backbone through which the European social cohesion and economic growth may be promoted and developed. Moreover, the impact of networks on the European economy is dramatic as the efficiency of the networks is the basis of European competitiveness versus strong competitors (US, Japan) and developing countries (China, India).

Under the umbrella "Networks" the European Commission does include all types of services that are offered to citizens such as transport (roads, railways, waterways, etc) that assure quick and safe mobility of persons and goods and other services (gas, water, energy, telecommunications, postal services, etc) that make our working and living conditions easier and more comfortable.

Although they may often be perceived as outdated, slow and inefficient in an age of tiny, shiny gadgets and devices, they continue to provide the backdrop of essential services that allow us to live in relative comfort and stability in dense urban centres and rural havens alike.

Civil infrastructure systems represent a huge public investment and are essential to the economic and social well-being of society. Unlike many other engineered systems, civil infrastructure is expected to provide reliable service for very long periods of time, spanning several generations during which society will experience dramatic changes in terms of available technology, as well as individual and collective aspirations with regard to life quality indices. There is increasing economic and political pressure not only to build new infrastructure, but also to extend the life of existing facilities and this in order to save on the cost of replacement and to avoid the high indirect costs associated with disruption of the transport, energy, commerce and communication networks that these facilities underpin.

Demands are also typically increasing over time, while at the same time a combination of environmental and operating conditions and deferred or ineffective maintenance may have caused deterioration in performance.

There are many indications that we have reached the crossroads of change in creating and managing our infrastructure: there is a need to push infrastructure systems to higher levels of efficiency under normal conditions, yet this must be balanced against reliability constraints under critical conditions, arising from natural or man-made hazards. Moreover, system interdependencies require considerable more attention and study.

One of the most important and potent factor that drives change, and raises expectations, is the development and use of information technology. ICT has the potential to address many of the critical issues in infrastructure systems but needs to be appropriately integrated with underpinning technologies.

Apart from public objectives, attention has been increasingly focusing on the universe of Networks in function of the changed expectations of users and citizens who, increasingly aware of their rights and needs, are more and more demanding in terms of the quality rather than of quantity.

Network operators and owners have shifted consequently from “passively” offering a product to offering instead an integrated service with a number of different functions.

Service must be safely and continuously available, accessible (territorially), affordable, meeting users’ demand and satisfying consumers’ expectations.

Any interruption of service, for technical, hazardous or human causes, has a strong negative impact, not only on public opinion, but also on the economic activities and, due to the interdependencies among infrastructure, will immediately result in an overburden of the others.

The role of the Networks is to assure the economic but sustainable development of Europe, by guaranteeing better living and working conditions.

It is understood that sustainability may be defined as: taking care in whatever we do so that future generations will not face additional burdens from the activities of today. Such burdens may be environmental pollution, depletion of natural resources as well as economical and logistical burdens.
1.2 IMPACT

Owners and operators of any network, whether at local, national or international level, are legally responsible for its correct, continuous and safe functioning and owe a duty of care to the public and the users/consumers.

This means that owners and operators must concern with aspects of safety and security, user satisfaction, congestion, maintaining asset value, sustainability, accessibility, while meeting local, regional and central government objectives on, for example, economic and territorial development, health and social issues.

All the above demand the maximum usage of the current networks and affect the way growth, operation and up-keeping of networks is funded.

Furthermore, to provide a commensurate return to governments and stakeholders (including citizens) on their investment in a network (by public money or according to tariffs), the service provided should be satisfactory, and shown to be so.

Operators and owners are therefore the natural interface between the needs of the collectivity and the political and governmental agencies and authorities.

Operators and owners represent in most cases the most important aggregated demand of technology for several sectors as engineering, construction, materials, plants, information technology, services, etc.

It is clear that the most part of the advanced European realisations are a consequence of the very high-level technological demand of the operators (i.e. nuclear energy, high speed-railways connections, etc).

Operators and owners guarantee the implementation and effective application of research results.

In this scenario it appears evident that the functional characteristics of the networks, as they are identified by the operators and owners, constitute one of the most important factors of technology development for several sectors in the Construction domain.

1.3 NEED OF INTEGRATION

Operators and owners can strongly influence the technological development in three ways by:

1. Research directly carried out when technologies and solutions are not actually or potentially present on the market. In this case, the operators must define the needed technical solutions and must pursue directly their implementation.

2. Joint research: in this case operators, contractors, material manufacturers, etc, should define a common strategy for the exploitation of R&D activities for global uses.

3. Influence on the R&D activities of third parties through technical specifications, operational requirements, etc., defined in the design and engineering phases.

Finally, it has to be stressed the profit of integration from different network systems as integrating solutions from different network sorts will lead to synergy, in applying solutions from one sort to others.
1.4 CHALLENGES

A number of key factors and challenges are facing the sector for the next years. First of all the enlargement of the Union which will result in the need of reaching very far away countries. Changes in use and habits of citizens and users such as their living conditions (urbanisation) will cause demand to increase. This in turn will impact immediately on their demand for instance for mobility and procurement of services, that will grow exponentially, and a change in mobility patterns as well as distribution patterns of utilities (gas, electricity, water and drainage).

Moreover the capacity of the infrastructure will have to meet this demand for mobility (volume and weights) thus existing assets will have to be upgraded and new constructions planned, connected and interoperable.

Demands for a more humane city: reintroducing ‘the humane’ quality of urban developments.

In the dense urban centres, the scarcity of space will require a division of the roadway system.

Ageing of population which will need ready access to convenient transportation.

More mobility and more types of mobility: The diversification of the modes of collective or individual trip-making as well as their intensification for various reasons must make it possible to integrate the new services offered by roads and streets.

Ageing of the networks and assets with different demands and different life patterns.

Climate change will impact directly on the availability of natural and in particular non-renewable resources such as fresh water supply or on phenomena such as sea rise and river capacity for waterways transport.

As far as it concerns the environmental impact, the pressure is enormous. It includes aspect linked to the physical presence of the networks on the territory, on the use and consumption of natural resources for construction and surveying and on a number of issues related to health and quality of life (noise, air pollution radiation etc.)

The sector will have to face the challenge posed by the fast development of ICT: ICT application will result in improving safety, efficiency, comfort and the environment. All involved stakeholders will benefit from their application not to mention infrastructure operators and public authorities. ICT will allow infrastructure operators to expand and optimise the infrastructure and its use. The implementation of these systems will impact on the way planning and design, realisation and operation of the network.

In this panorama, durability issues and life extension and life-cycle approach, considered as a sustainable objective, will have to be faced.

Optimal allocation of available economic resources will have to be met considering that economic pressure both on industry and on public cannot grow constantly.

Finally it proofs extremely difficult to match ‘demands’ with ‘shown to be satisfactory’. In this field, development of regulation and legislation, which is increasingly European directed, must be in harmony with network solutions in reality and ‘consumer satisfactory’.

In synthesis, the challenges in the network area can be summarised as follow:

- Urbanisation
- Changing mobility patterns and Traffic growth and modal redistribution
- Telecommunication growth and ICT impact
- Technology transfer and implementation
- Ageing of the assets
- Resources management: climate change (i.e. greater water consumption)
  - changes in volume and distribution patterns of electricity and gas
  - nature and landscape (i.e. floods)
- Financing: changes in infrastructure ownership and new forms of financing
- Environment:
  - increasingly limited resource use and environmental pressures
  - increase in durability and damage growth
  - sustainability
- Risk management (natural hazards and external risks such as terrorism)
1.5 EXPECTED BENEFITS

In the next years therefore, as a result of the implementation of the Vision it will be possible for the owners and operators to carry their networks to a new level of service to:

- Guarantee functional networks and services responding to the needs of users and clients by adopting solutions, techniques and materials that extend the life-cycle, increase capacity and durability with low impact on operation and with high standards of safety and security
- Support the economic development both at the European and national level
- Support the territorial development and take care of protecting and increasing the value of the territory by a better development of design and construction with use of environmentally-friendly materials and technologies
- Cover a leading role both at national and international level to strengthen networks, assets and related innovative services as a major engine for economic European growth and expansion
- Safeguard safety and guarantee security by adopting ICT systems for a quick exchange of information and management tools able to predict and quickly restore service conditions
- Increase efficiency and efficacy by adopting models
- Broaden dialogue with all stakeholders to meet users’ demand, increase consumers’ satisfaction and meet public requirements
- Create added value for shareholders and stakeholders, reduce costs for ownership and increase the ROIs of their own companies by a better management and allocation of economic funding as a result of the implementations of the innovations proposed

1.6 EXPECTED OUTPUTS FROM RESEARCH AND INNOVATION

It has to be stressed that in developing the Vision for this Focus Area, attention must be concentrated on the strong relationship between networks and the environment: all the new networks and the operation of the existing assets present a relevant impact on the involved territories in terms of environmental transformation and need for materials.

In this case a fundamental R&D approach must be addressed to specific sectors:

1. Environmental sustainability
2. Re-uses and disposal of materials coming from existing networks

The general expected outputs of the strategic plan may be reached for this specific Focus Area by implementing these technical and technological objectives, common to all the networks of infrastructures of transport or service, covered in the Focus Area:

- New criteria of service
- New criteria for safety and reliability
- Advanced capacity of connecting the networks to the territory
- Advanced capacities of connecting the networks with the communities
- Development of new advanced techniques and systems ICT and ITS
- New models for managing existing assets
- New models for maintenance/upgrading/replacement
- New monitoring and maintenance techniques
- New degradation models
- New models for managing new networks
- Integrated conception of the life cycle of networks
# 1.7 STRATEGIC PLAN

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Problem</th>
<th>Objective</th>
<th>Breakthrough/Innovation required</th>
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<tbody>
<tr>
<td>Inter-operability</td>
<td>From competitiveness to co-operation</td>
<td>New integrated concepts of multimodal infrastructure design for shared structures Interoperability and integration of information/communication to increase security &amp; safety of networked systems</td>
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<tr>
<td>Impact on territory</td>
<td>Relation with the territory</td>
<td>New system for design and planning, upgrading and building able to minimise the impact on the environment Insertion of new networks in the environment minimising consumption of natural non-reproducible resources</td>
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<tr>
<td>Impact on environment</td>
<td>Construction/maintenance/management</td>
<td>Optimisation of the application of new materials, construction, maintenance and demolition techniques able to reduce consumption of natural resources and allow recycling and reuse of used materials</td>
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<tr>
<td>Operation</td>
<td>Life-extension</td>
<td>Optimisation and upgrading of management and operational tools to assure increase in durability with an optimal response to demand, lower impact on service and optimal use of economic funding</td>
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<tr>
<td>Monitoring</td>
<td>Intelligent materials (nanotech, ICT, ITS) and solutions able to extend life-cycle</td>
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<tr>
<td>Inter-modality</td>
<td>New rules of cooperation among operators</td>
<td>New integrated concepts to take into account the development in use and habits of users and citizens</td>
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<tr>
<td>Safety and security</td>
<td>Increase in safety (vulnerability of networks)</td>
<td>New models, design and building techniques, materials and ICT to increase safety and reduce the risks for users and citizens from external and natural hazards</td>
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<tr>
<td>2020</td>
<td>Increase in the quality of life (citizens and users)</td>
<td>Reduction of environmental impact (pollution, vibrations, radiations, noise) New techniques, materials and engineered solutions to reduce impact and negative effects on users and communities due to transport and service daily activities</td>
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<tr>
<td>Safety of users (people)</td>
<td>Increase in intrinsic safety</td>
<td>Application of new materials, construction and demolition techniques able to reduce consumption of natural resources and allow recycling and reuse of used materials</td>
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<tr>
<td>Safety of users</td>
<td>Safety of users</td>
<td>Integration of solutions (tools, materials, techniques, models, ICT) that increase safety and mobility and reduce the risks for users and citizens from external and natural hazards</td>
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<tr>
<td>Maintenance</td>
<td></td>
<td>Design, development and application of new materials product and maintenance techniques based on available reliability and service life (advanced BD)</td>
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<td>Optimal management of life cycle of new and existing structure</td>
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<td>Development of new assessment methods and models for the reliability and performances of structures and taking into account the whole life cycle including deterioration with the aim of optimizing the structures</td>
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<tr>
<td>2010</td>
<td>New assessment methods and models</td>
<td></td>
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<tr>
<td>Impact on the environment</td>
<td>New management and operational tools</td>
<td>Design, development and application of management and operational tools for optimal use of economic funding</td>
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<tr>
<td>Materials and structure</td>
<td>Design and development of construction and demolition techniques for recycling and reuse of materials Improve traditional materials and constructions techniques in respect with sustainable development Improve knowledge about ageing of materials and structures</td>
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<tr>
<td>Advanced ICT in service</td>
<td>Advanced ICT system (toward the users)</td>
<td>Implementation and integration of solutions to improve communication between users, infrastructure and operators, to improve vehicle utilisation, to reduce fuel costs, detour and optimising deliveries</td>
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<tr>
<td>Security</td>
<td>Increase of security</td>
<td>New system, tool and ICT that increase security against terrorism, malicious and intentional hazards</td>
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**FIGURE 1 : STRATEGIC PLAN**
THE NETWORKS OF TRANSPORT

Vision 2010, 2020, 2030 and fields of research
- Roads and Highways
- Railways
2 THE VISION FOR THE ROADS AND HIGHWAYS

2.1 BACKGROUND AND PRESENT POSITION

The road infrastructure must be seen as an integrated, pre-arranged product, able to receive and deliver a number of services in response to a precise demand of the users and of public at large. Therefore, the road infrastructure must evolve from the old concept of an asphalt strip to become an "intelligent" infrastructure able to provide any advanced service that the "more and more computerised" user (car, mobile, etc) may demand.

Infrastructure must evolve toward an interactive transport: it is not only traffic that travel on the infrastructure but also information

The transport system represents a fundamental factor for the economic and social development of Europe, as it allows the quick, safe and easy exchange of passengers and freight.

The transport sector employs a large number of personnel (1 million in rail transport and 2.6 million on road transport). The transport of goods and personnel accounts for 32% of the energy consumption in the EU.

A complex equation has to be solved in order to curb the demand for transport as economic growth will almost automatically generate greater needs for mobility, with estimated increase in demand of 38% for goods services and 24% for passengers (2010)

Enlargement will generate an explosion in transport flows in the New Member States, particularly in the frontier regions.

Saturation of the major arteries combined with accessibility of outlying and very remote areas and infrastructure upgrading in the candidate countries will in turn require massive investment

Accessibility to urban zones is in jeopardy due to the change in use and habits of citizens (commuters and freight transport).

If we consider road transport, for instance, the transport on road dominates the person transport (79% of the total person-km transport) while it accounts only for 44% of goods transport.

It is still expected that road transport will continue to grow at a rate of 2-5% each year, corresponding to a 100% increase during the next 15-35 years.

As a consequence of this uneven distribution of traffic, the problem of congestions is expected to spread out on the major trunk roads and trans-European corridors, with a 10% of traffic jams, as well as in the industrial and urban areas where saturation may be forecast. To complicate this scenario, it must be said that the car fleet is expanding by 3 million vehicles each year in the Union. Chronic congestion is experienced also on the rail system as well, with a 20% of the network classed as bottlenecks.

Road traffic accidents are responsible for many thousands of deaths in Europe and the Commission has committed itself to halving the number of deaths by 2010.

In addition road traffic is responsible for the majority of noise pollution and a growing proportion of Europe's local and global air pollution. Maintenance of the highways also consumes considerable amounts of energy and raw materials, as well as increasing traffic congestion.

Limited new constructions are planned, the most of it is currently taking place in the regions and countries furthest from the center, to help their economic development and favor the access to the central market. To answer to this increasing demand for mobility, larger interventions of maintenance, repair and upgrading will be necessary with, of course, a negative impact on the circulation and a larger demand of funding.
2.2 MANAGING THE ASSET

Owners and operators will experience a large increase in the use of their networks over the next thirty years. The network industry will only be able to respond to this challenge by either building new infrastructure, increasingly reducing bottlenecks, and incrementing the capacity and mobility.

Within the constraints of current funding, the construction of a large number of new arteries is not feasible, so efforts will have to be concentrated on maintaining and upgrading existing assets. The challenge to the construction industry is to ensure that existing infrastructure can be maintained and renewed without unduly disrupting the traffic and without prejudicing the levels of safety currently necessary to guarantee a good level of service. This is the main area that needs to be addressed through new technological research and innovation.

Generally, infrastructure systems comprise structural components and assemblies as well as mechanical and electrical equipment. In contrast to the latter, the former are often more difficult to inspect, repair or replace, and their assessment involves processes which are subject to considerable variations resulting from limited knowledge, variable levels of experience and judgement, and subjective evaluations of the factors that may lead to unacceptable performance. In fact, the very notion of unacceptable performance is subject to imprecision and fuzziness, hence the focus of considerable debate amongst professionals, regulatory bodies, owners and operators.

The majority of the decisions required during the process of assessment, maintenance and management of ageing civil infrastructure are made under conditions of uncertainty. Uncertainties are associated with mechanical loadings, environmental stressors, material properties, simplifications and idealisations required for modelling to list some of the major areas of influence. Moreover, these sources of uncertainty are compounded by human and organisational factors that are an indispensable part of the processes employed by the profession. Most importantly, these uncertainties are not fixed but change considerably over time and space, even when considering one structural element in a single structural system. It is therefore practically impossible to assess present performance with certainty, and is even more demanding to predict future performance with confidence.

In view of the above, the civil engineering profession has, over the past twenty or so years, moved rapidly in exploring methods that can capture elements of uncertainty, imprecision and fuzziness for decision support. Collectively, these attempts have led to a host of techniques based on probabilistic principles that are increasingly being used in different application fields, such offshore, nuclear, bridge and marine engineering. Methods for structural reliability assessment are now well developed and can be used for practical applications, even though progress in dealing with deteriorating, time-variant complex systems is still urgently required. Quantitative methods for risk analysis are also being used to deal with hazard identification, scenario representation and risk evaluation in many situations.

However, there is an acute need for developing a unified methodology for risk-based decision analysis by integrating the available methods, including those being used human and organisational factor analysis. At the same time, much effort has been directed at developing and improving diagnostic tools, including system identification, sensing and monitoring methods, and their interpretation for decision making. Information technology is having a large impact on both the acquisition and processing of the information that can be obtained from these systems. In this respect, our ability to model, analyse, predict and manage infrastructure systems is, in principle, growing at an increasing rate. However, dealing with vastly more data and information, and turning this into knowledge and wisdom poses formidable challenges for researchers, owners and regulatory bodies, especially as this must happen whilst the complexity and interdependency of infrastructure systems is also set to increase.

An integrated holistic approach is needed in order to understand and quantify the effect of complex technological, environmental, economical, social and political interactions on the life-cycle performance of civil infrastructure systems. Concerted effort is required on many different fronts, including materials, construction and maintenance techniques, structural analysis and simulation, risk and reliability, information technology, life-cycle and systems engineering. The objective is to push civil infrastructure systems to higher levels of efficiency under both normal and critical conditions, yet balance this against socio-economic and political constraints.
### 2.2.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
<th>Breakthrough/innovation</th>
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<tbody>
<tr>
<td>2010</td>
<td>Development of new assessment methods and models based on performance, reliability and service life cycle. These new methods must be applicable in each phase of the life cycle.</td>
<td>Design, development and application of • new materials • models of ageing for traditional materials • monitoring systems • construction techniques • maintenance techniques • demolition techniques</td>
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<td></td>
<td>Design, development and application of new materials, monitoring systems, construction and maintenance techniques able to meet increasing demand, to extend lifecycle, to meet new standards, to reduce disruptions of service, to increase the level of service</td>
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<td></td>
<td>Design, development and application of new materials, construction and demolition techniques able to reduce consumption of natural resources and to allow recycling and reuse of used materials</td>
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<td></td>
<td>Management and operational tools to assure optimal mobility, lower impact on service, optimal use of economic funding</td>
<td>Design, development &amp; application of management and operational tools</td>
</tr>
<tr>
<td>Horizon</td>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>Optimisation of the application of new materials, construction and demolition techniques able to reduce consumption of natural resources and allow recycling and reuse of used materials</td>
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<td>Optimisation and upgrading of management and operational tools to assure optimal mobility, lower impact on service, optimal use of economic funding</td>
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<tr>
<td>Horizon</td>
<td>Objectives</td>
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<tr>
<td>2030</td>
<td>Networks relation with the territory will be modified: • New systems for design and planning able to minimise the impact on the environment • New concept of design and upgrading resulting in a reduced impact on circulation • Insertion of new networks in the environment minimising consumption of natural non-reproducible resources • New integrated conception of systems to take into account the development in use and habits of users and citizens</td>
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### 2.2.2 FIELDS OF RESEARCH

#### 2.2.2.1 MODELLING THE PERFORMANCE OF THE INFRASTRUCTURE

Development of models to assess and follow the performance of structures over time to keep into account their transformation and deterioration with the aim of extending their life cycle: from deterministic to fully probabilistic models of deteriorated structures

Assessment of the modification of the structural performance of structures subject to ageing and increased loads

Development of models to assess the properties of soils under increasing loads and with the aim of reducing impact of maintenance

Development of models for traffic loads

Development of models to predict pavement performances on changing conditions and costs

Development of models for prediction of the response of the structure to seismic and other natural hazard actions
2.2.2.2 MONITORING THE PERFORMANCE OF THE NETWORK

Development of new sensors and techniques that could guarantee a multifunctional approach. New systems of measure of significant parameters, definition and integration of the minimal set of significant data, development of systems for use into daily operation activities and for use during construction.

Definition and implementation of a technological approach that allows the maintainability and replacement at a low cost of instrumentation

Development of models that take into account the significant phenomena that describe the performance of structures (bridges, pavements, embankments)

Application, use and integration of monitoring systems into life-cycle prediction models to evaluate future maintenance needs with optimisation of financial resources and low impact on demand

Optimisation of inspection planning. Development of risk based inspection regimes to minimise impact on traffic and to minimise inspection costs.

Development of non-destructive, automated and scanning non-destructive inspection techniques for reliable assessment of non-accessible elements to minimise impact on traffic.

Development of long-term monitoring of existing structures, to be integrated as decision tool in an asset management strategy Application, use and integration of monitoring systems into life-cycle prediction models to evaluate future maintenance needs with optimisation of financial resources and low impact on demand.

Data fusion and data processing. New sensory systems for measuring physical/chemical parameters. New sensory systems for the infrastructure environment. Dissemination of SHM systems. Integration over large geographical networks. Integration of SHM and security monitoring systems

2.2.2.3 IMPROVING THE PERFORMANCE OF THE INFRASTRUCTURE: MATERIALS AND CONSTRUCTION TECHNIQUES

Materials

New generation of materials whose use change the performance characteristics of the structural components

New materials for maintenance and repair with enhanced performances to extend the durability, with low impact on the environment and with minimal impact on circulation as it concerns their practical application

New materials with improved performances and multifunctional characteristics (i.e. smart materials or materials with sensing capabilities)

Interaction between monitoring and materials

Design, build and operate with new or non-conventional materials

Models and technologies for use of bio materials

Use of waste material or industrial by product

Analysis of the ideal profile of materials to be used in repair work on single infrastructural reinforced concrete elements (piers, beams, bearing blocks, concrete bedding, New Jersey barriers, etc.).

Pavements

Road pavement construction and maintenance low costs techniques including life-cycle optimization and re-use of material

Road pavement construction and maintenance fast and long lasting techniques using precast solutions (modular concepts of multifunctional structures) with value added services for mobility

Road design/construction & maintenance procedures and techniques able to carry out the time-sequenced transformation of the use -functions of road infrastructures

New generation of materials able to resist environmental aggression

New solutions able to increase comfort for users

Smart & high performance road materials (multifunctional & adaptive materials, nano-structured & self-assembling, advanced structural material systems) with an evolving use –functions capability in order to overcome the development of critical phases during the operation and management of infrastructures
**Construction/maintenance techniques**

New techniques and technologies for repair, upgrade, even under vertical loads, maintenance, enlargement and substitution of the different components of the infrastructure in particular for bridges with the lowest impact on traffic and environment.

Increase in the useful life of the repaired element as a consequence of the greater durability of the actual material and the industrialization of the application process that relies increasingly less on the quality of the applier.

General planning of all the periodic repair work on the basis of the reliability data obtained through the “intelligent” monitoring of the techniques and the materials used for repairing the reinforced concrete.

Development of techniques for maintenance and enlargement assuring safety conditions with no interruption of service.

Development of new techniques, technologies and treatments with particular attention to earth engineering that would improve durability and increase capacity with no impact on mobility.

Development of techniques of re-use of materials with the aim of global re-use with a substantial reduction of the consumption of natural resources.

New techniques of demolition that allows recycling and reuse of materials (considering internal re-use or towards other applications), even more than one time.

New techniques for dismantling, decommissioning and re-employment of components.

New techniques for construction with low impact on environment and reduced construction time (including equipment) and with industrialisation of components to reduce construction time thus with a lower impact on circulation.

Development of reuse of foundation elements (piers, embankments, soft soil), techniques.

New techniques for very cold weather and extreme conditions.

**2.2.2.4 ENHANCED MANAGEMENT**

Develop new ideas for network-wide management and operations, with an emphasis on customers in the provision of services.

Development, feasibility and application of models and tools for the optimal management of maintenance with low impact on service.

Development, feasibility and application of models and tools for the optimal management of maintenance and upgrading with low impact on service (including probabilistic approaches, life cycle management procedures, economic cost-benefit analysis procedures, optimisation procedures considering restricted budget, comprehensive approaches including data management, inspection, planning and realisation procedures).

Development, feasibility and application of models and tools for the optimal operation of networks with low impact on service (including roadwork management, approval procedures for heavy load transport, ...).

Development of models and tools for risk and safety management integrating issues such as safety culture, business processes, roles and responsibilities, training and competency, quality and performance management, etc. which ultimately have a major impact on the safety of operations.

Development of full asset management systems which consider all important infrastructure components.

Development of management procedures suitable for smaller regional and local networks.

Development of a series of assessment standards on European level for structures complementary to the existing standards for the design and construction of new structures.
2.3 ENVIRONMENTAL IMPACT (SAFETY TOWARD CITIZENTS AND ENERGY)

Creating a global vision for the road infrastructure of the future is aimed at selecting in particular environment-friendly and suitable concepts in order to strike a compromise between reduced global construction/maintenance costs, safety and environmental criteria.

A sustainable use of resources including the recycling of materials is an important need.

Urban and suburban air quality is improving but the resident populations are still exposed to pollution levels that pose health risks. Vehicle technology has been effective in reducing the transport emissions but a large number of people, particularly in urban and suburban areas and not only frontages, are still exposed to high pollution levels, and this will continue to be the case in future. While much attention is given to emissions and energy use of road transport, other impacts on the human and natural environment also require attention as road traffic noise.

In spite of noise regulations and legislation that have existed for long time in many Member States, the number of European citizens that are annoyed by environmental noise shows an ever growing tendency. The area where a quiet atmosphere can be experienced is reduced by the increased density of urban areas and particularly by the growing mobility.

2.3.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
<th>Breakthrough/innovation</th>
</tr>
</thead>
</table>
| 2010    | New materials and technical solutions to prevent, reduce impact and negative effects (noise, pollution, radiation, vibration, etc) on users and communities due to transport and service daily activities  
Preservation of resource environment                                                            | Design, development and application of:                                                |
|         |                                                                                                                                                                                                            | • New materials                                                                       |
|         |                                                                                                                                                                                                            | • Technical solutions                                                                 |
| 2020    | Optimisation of new materials and technical solutions to reduce impact and negative effects (noise, pollution, radiation, vibration, etc) on users and communities due to transport and service daily activities |                                                                                       |
| 2030    | New approaches to networked systems minimising environmental impacts on communities and natural habitats                                          |                                                                                       |
2.3.2 FIELDS OF RESEARCH

Materials and pavements
Reuse of materials after spilling of dangerous or polluting materials
Innovative roads using environmentally-friendly materials and their impact on maintenance
New techniques and technologies to abate pollution of the environment due to the traffic road
New techniques and technologies to avoid pollution of the environment in case of accidents involving dangerous and hazardous goods
New techniques of intervention in the presence of events environmentally dangerous
Road pavement construction and maintenance low impact techniques including new maintenance and re-cycling techniques and the integration of composite materials
Ecotechnical road infrastructure by using passive/partially passive/ active systems solutions for traffic noise, vibration, air & water pollution control
Road pavement materials that reduces the rolling noise emission, Verification of the technical and economic feasibility of the technological solutions that are under research

System solutions
Design for environment (including cost/effectiveness performance analysis) to integrate the innovative systems solutions
Energy recovery, use of alternative energy sources and efficient use systems solutions
Reducing the use of natural resources
Structural design and construction techniques to reduce noise and vibration transmission to the environment
Application of new solutions such as sludge to new roads and assessment of their life cycle needs
Soil decontamination techniques
Improvement in the relation between the infrastructure and the territory or the urban area: procedures to prevent future conflicts with uses of land due to noise annoyance and techniques to integrate the infrastructure into the territory
Economic and social benefits
2.4 SAFETY, SECURITY AND SECURITY OF DEMAND

2.4.1 SAFETY

Road infrastructure is already congested if not rapidly reaching saturation. This is true not only along Trans European corridors and major highways, but also in urban areas where access of commuters and freight transport is causing serious problems. Traffic demand is expected to grow at least by 30% in the next 10 years, while transport network investment by only 5%.

Management of networks at their optimal capacity is becoming a must.

ITS implementation will result in better safety, efficiency, travel comfort and environment. Commercial vehicle operators, individual drivers and public transport users alike are already benefiting from ITS not to mention the infrastructure operators and public authorities.

ITS will allow infrastructure operators to expand and optimise the infrastructure and its use. Innovation such as automatic tolling, coordinated traffic signal control, motorway ramp metering, variable message signs and traffic and incident detection systems help minimise delay and increase overall capacity. This will result in fewer and shorter delays and congestions and improve air quality and reduce fuel consumption. The implementation of these ITS systems will impact on the way planning and design, realisation and operation of the network is done, in logic of "plug and play”

Moreover the capacity of the infrastructure must meet this demand for mobility (volume and weights) thus existing assets will have to be upgraded and new constructions planned.

Costs and traffic delays can also be reduced with a better management of road works and special events (sporting). Road users will be better informed resulting in increased satisfaction and a potentially positive image of the sector for public at large and government bodies.

2.4.2 SAFETY OF DEMAND

One of user’s prime concern is road safety. Of all modes of transport, transport by road is the most dangerous and the most costly in terms of human lives. Sensitiveness for this problem has grown up in the past years among the drivers’ community and road accidents always cause a strong reaction also in public opinion. The price paid in terms of human lives (direct or indirect) for mobility is too high.

Drivers demand improved road quality, stricter road safety measures, improved traffic management, enforcement of traffic regulations, better training of drivers, checks on vehicle safety and road safety campaign.

It is the target of the European Commission to halve the number of death by 2010.

Efforts should be done to prevention of road accidents including actions on the infrastructures itself (components, materials, technical solutions) and in traffic management systems.

2.4.3 SECURITY

Security has recently come to the fore as a global challenge due to world events and societal changes. Europe needs to invest in this field in order to effectively and innovatively address existing and future security challenges (including natural and external risks).

Factors and aspects such as structure reliability, human and organization factor, model of risk analysis for people, behaviour model, scenarios, information of drivers,

Interaction on networks in case of hazards, crashes, consequences of an accident and mitigation of disasters should be taken into account.

Seismic risk has a great impact on the functionality of the road and railway transportation networks. An earthquake can compromise the overall network and impede the connections between the fundamental nodes of the network for the rescue operations and for the transportation of the first aid supplies. The probability that an event producing such a scenario occurs in the European most seismic areas is of the order of 10-20% in 50 years.

Although the collapse of the transport infrastructures can derive from phenomena induced in the ground, such as landslides, dynamic liquefaction, local ruptures, settling of embankments, etc. there is no doubt that the most vulnerable elements are bridges and viaducts.
Most part of the structures of the land transport network in the European countries subjected to seismic hazard are inadequate to resist earthquakes that are likely to occur during their lifetime, according to current standards. On the other hand scientific and technological advancements have been and can be further made to reduce drastically the risk.

The advancements in the measurement and telecommunication areas permit to realize monitoring systems able to put under a continuous control any type of construction, in order to check the structural effectiveness in any moment, to evaluate the seismic response during an earthquake and the damage state after a seismic event.

### 2.4.4 VISION 2010, 2020, 2030

<table>
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<tbody>
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<td>2010</td>
<td>To identify, implement and integrate solutions that can improve communication between users, the infrastructure and the operators, thus improving vehicle utilisation by 15% and reducing fuel costs by 10%, reducing the number of km to run and detour, and optimising deliveries.</td>
<td>• Definition of the needs of the operators in terms of public demand and in terms of management and operation impact; • Technical and economic feasibility of the technological solutions available on the market or under implementation; • Definition of a plan or roadmap to apply this technologies, considering also their integration to respond to a number of functions • Evaluation of impact on the users, to reduce the costs • Improving situation awareness; • Protecting against terrorism (detection protection-neutralisation), • Protecting against natural hazards • Increase scientific knowledge on behaviour of components under risk</td>
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<td></td>
<td>To identify, implement and integrate solutions (development of tools, materials, techniques, models, ICT) that increase safety and mobility and reduce the risks for users and citizens form external (i.e. terrorism) and natural hazards</td>
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<tr>
<td>2020</td>
<td>To identify, implement and integrate solutions (development of tools, materials, techniques, models) that increase the seismic safety of transport infrastructures, through the reduction of the vulnerability of components, routes, networks.</td>
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<tr>
<td>Horizon</td>
<td>Objectives</td>
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<tr>
<td>2020</td>
<td>Definition of the interaction and reduce the impact that new techniques and technologies will have on the structural components of the infrastructure whose design and production will change, when implemented in practice 1. Evaluation of the impact on the &quot;physical&quot; infrastructure or how it could be structurally modified, during production, realisation and operation, for the application of these technologies in logic of plug-and-play. 2. Evaluation of the impact on the interconnection and interoperability of networks to allow the quick exchange traffic and information to reduce traffic locks-ups.</td>
<td>1. Evaluation of the impact on the &quot;physical&quot; infrastructure or how it could be structurally modified, during production, realisation and operation, for the application of these technologies in logic of plug-and-play. 2. Evaluation of the impact on the interconnection and interoperability of networks to allow the quick exchange traffic and information to reduce traffic locks-ups. Optimising security and protection of networked systems -(transportation facilities, utilities): security of use-vulnerabilities-interdependencies Enhancing crisis management (evacuation-search and rescue operations-active agents control and remediation) Significant reduction of the seismic risk should come from the applications of the findings of the studies carried out in the previous period</td>
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<tr>
<td>Horizon</td>
<td>Objectives</td>
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<tr>
<td>2030</td>
<td>Interoperability and intermodality: shifting from competiveness among different networks to integration as offer of alternatives (i.e. between transport modes) is fundamental to assure fast and safe mobility in a competitive Europe. Achieving interoperability and integrated systems for information and communication to increase security and safety of networked systems Achieving full protection from seismic risk of transport infrastructures and implementing efficient multifunctional monitoring systems</td>
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</tbody>
</table>
2.4.5 FIELDS OF RESEARCH

Safety

Fleet and freight management: Improving mobility (reduced and optimised travel time, with a lower consume of fuel) by tracking vehicles (in particular trucks and cargo) thus optimising delivery and respecting tight deadlines for a more competitive European economic market. Interoperability can be facilitated with freight tracking systems that allow the seamless transfer of goods from one mode to another.

Traffic management and monitoring: Implementation and impact of tools for the optimal management and control of traffic for a more efficient traffic flow, also in presence of works sites and special events, and quicker clearance times for incidents, road.

Collection of data (loops, cameras, DSRC infrastructures, sensors) data processing (traffic management control centres).

Information to users: Delivering interactively of real-time traffic and weather information to users to reduce risks and speed travel time, resulting in increased satisfaction with road transport services.

Information dissemination, pre-trip and on trip.

Tolling operations: Optimisation of the impact of tolling operations on design, realisation and operation of the infrastructure.

Communication infrastructures: wired (fiber optics) and wireless (radio, Wi-Fi, cellars networks).

Application of Information Technology (IT) to transport, which could include: intermodal route planners, parking control systems, fleet management, dynamic traffic control systems, passenger information and so on.

Safety of demand

Incident management: Early identification of incidents so that effective traffic management strategies can be implemented to reduce impact on infrastructure and on public demand (mobility)\(^1\)

Road safety: Take advantage of intelligent vehicles and infrastructure technologies to improve safety.

Improve road design concepts in relation to road safety.

Environmental risk: Systems and technologies to help users in case of adverse climatic conditions, such as fog, rain, snow, etc.

Emergency calls: Suitable management and operative processes to deal with emergencies to speed up rescue operations and restore mobility.

Transport of hazardous goods: Reduction of risks in transport of hazardous materials in densely populated or environmentally sensitive areas or transport of exceptional loads by locating and monitoring transport and providing efficient and fast appropriate measures in case of accident. It will finally result in a input for maintenance and rehabilitation of infrastructure impacting on the life cycle assessment of the infrastructure itself.

Systems and technologies to help users in case of adverse climatic conditions, such as heavy rain, wind, freezing, etc.

New fire-resistant materials and fire protection methods, which may guarantee the safety of users on fire disasters.

Development of new structure monitoring system which warns the operator on structural risks, being the operator able to take enough preventive actions for the users' and structure safety.

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\(^1\) Incident management should promote an uninterrupted flow of traffic in designated areas or roadways, censure necessary action is taken to remove or minimise any impediment to the free flow of traffic and to provide assistance services, vehicle and asset maintenance services as necessary (data collection, data analysis, information deliver/traffic management strategy implementation)
Security

Experimental and theoretical studies on the seismic response of bridges and viaducts, taking correctly into account the three-dimensional character of their response, of the characteristics of their constraint devices and of the flexibility of their foundations, on the actual behaviour of the most critical elements. Studies on the soil-structure interactions and of the non-synchronism of the soil motion under the piers. Experimental and theoretical studies on the design procedures and on the techniques for the improvement of the seismic response of new bridges and viaducts, in relation to their specific characteristics.

Experimental and theoretical studies on the design procedures and on the techniques for the seismic upgrading of existing bridges and viaducts, in relation to their specific characteristics, with particular attention towards the techniques which reduce the impact on traffic and on the environment. Experimental and theoretical studies on the antiseismic technologies which make use of materials which are able to provide a greater durability and lesser maintenance needs.

Setting up of models and criteria to define optimal strategies for the reduction of the global seismic risk, on the basis of the already available data or of purposely obtained data. The criteria shall account for the risk of the single structure and of its importance in the network, in order to plan the seismic upgrading interventions in a maximum utility logic.

Setting up and implementation of monitoring procedure and system at low cost, immediately accessible soon after an event, which can provide direct information on the behaviour of a bridge during and after an earthquake and on the damage state soon after the earthquake. It will make it possible an immediate evaluation of the impact of the earthquake on the vulnerable elements of the network. The monitoring systems shall be multifunctional, in order to provide information on the condition of the structure all along its useful lifetime, periodically or after some particular events.

Development of models, materials, monitoring systems, components, design and construction techniques able to reduce the vulnerability of structures to natural hazards in order to guarantee the functionality of the network.

Research on new materials that guarantee the structural integrity upon natural hazards, mitigating the risks on these disasters.

Development of new structures based on these materials which decrease the risks, and therefore the human fatalities, on natural catastrophes and their economic convenience.

Roadway-perception technology solutions to improve drivers vision under all weather conditions with reflective materials or light.

Physical adaptation of infrastructure by using smart materials/devices for the precast solutions of modular concepts for multifunctional infrastructure.

Interactive infrastructure linked to owners, users, frontage residents and external control systems.

Security Policy and planning

Pre-incident preparedness and Incident reaction

Criteria establishing investment priorities

Design criteria to mitigate threats (vulnerability) or to mitigate consequences.
2.5 INTEGRATION WITH OTHER NETWORKS

“Transport is a key factor in modern economies. However, there is a permanent contradiction between society, which demands ever more mobility, and public opinion, which is becoming increasingly intolerant of chronic delays and the poor quality of some transport services.” (White paper - European transport policy for 2010: time to decide)

There is a need to push our nodal infrastructure system to higher levels of efficiency and competitiveness to be combined with the need to ensure minimum levels of service, reliability, and security, even under critical conditions. To set the scene, some recent history is given, and infrastructure system are described in terms of their performance, interdependencies, and vulnerabilities.

World population is expected to expand by 1.0% pa on average over the next 30 years. And in Europe, while in the central and in the eastern parts the population is projected to decline, in the OECD countries is forecast to be stable, from 158 million inhabitants in 2000, to 159 in 2030 (source: Poles/EU).

Totally, the EU 15 population growth will be of the 0.09% pa from 2000 to 2030 (source: Eurostat Primes). The population trends in EU 25, will have an increase of 0.03% pa from 2000 to 2030 (source: Eurostat).

World GDP (expressed in purchasing power standards) is expected to grow by 2.9% pa on average between 2000 and 2030, while in the OECD region GDP growth will be limited to 1.9% pa up to 2030.

In EU 15 countries, the rebounding trend is assumed to continue over the horizon to 2010, resulting in an overall growth rate for 2000-2010 of 2.4% pa, around 2.3% pa for 2010-2020 and 2.2% pa for 2020-2030 (source: Eurostat, Economic and financial Affairs DG, Primes).

The EU 25 economic outlook, reach an annual growth rate of the per annual GDP of 2.38 % pa (source: Eurostat, Economic and financial Affairs DG, Primes, ACE).

Weather conditions, which are important in determining both the intensity and the overall pattern of energy and transport use, are assumed to remain unchanged over the projection period 2000-2030 (source: Eurostat).

The increasing of traffic in EU networks, is directly linked not only with demographic growth, but mostly with the macroeconomic development. All these factors, will contribute in the future to a critic situation of saturation of the infrastructure's line, and especially node.

We also have to consider that one of the most important problems on the existing European network is the fact that different products and people with different speeds share the same "line".

In order to change this situation, and to build a more competitive network, we must study new infrastructural line but especially new infrastructural nodes.

In fact from projects and design of new nodes, with a high presence of multimodal system available for passenger and goods, we can reach a quick exchange global system with lower costs. This mean that at the same time we must reach higher service level on the "line".

The principle aims of this task are: quicker exchange, higher speed, a multiple choice system, safety, security, protection against terrorism and natural hazard.

The target will be: way and highways and their relationship with harbors, airports, inter-ports, railway stations and all others nodes of the networks.
### 2.5.1 VISION 2010, 2020, 2030

<table>
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<tr>
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<th>Objectives</th>
<th>Breakthrough/innovation</th>
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<tbody>
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<td>2010</td>
<td>Design, development and application of new nodal infrastructural system, junction and urbanization.</td>
<td>New nodal infrastructural system, junction and urbanization</td>
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<td>New approach to the study of use and habits of users and citizens.</td>
<td>Study on the use and habits of users and citizens.</td>
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<td></td>
<td>Design, development and application of new logistic, transport and quick exchange people traffic system.</td>
<td>New logistic, transport and quick exchange people traffic system</td>
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<tr>
<td></td>
<td>Design and development of networked systems of infrastructure against terrorism and natural hazard.</td>
<td>Systems and methods for the integration of networks</td>
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<tr>
<td>2020</td>
<td>Optimization of new nodal infrastructural system, junction and urbanization.</td>
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<td></td>
<td>Optimization of new approach to the study of use and habits of users and citizens.</td>
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<td>Optimisation of new logistic, transport and quick exchange people traffic system.</td>
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<td>Optimisation of the infrastructure against terrorism and natural hazard</td>
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<tr>
<td>2030</td>
<td>New nodal systems are built.</td>
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<td>Reaching a new way to build other nodal, junction and urbanization system.</td>
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<td>New integrated concepts of multimodal infrastructure design for shared structures</td>
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<td></td>
<td>Achieving interoperability and integrated system for information and communication to increase security and safety of networked system</td>
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### 2.5.2 FIELDS OF RESEARCH

#### Conceptual solutions

- New models to simulate cost/benefit
- New models to simulate multimodal use against monomodal use
- New infrastructural node: design building for high speed transport and highways.
- New multiple choice/ multiple speed infrastructural system near road.
- Point of interoperability and intermodality
- New concepts of multimodal infrastructure design for shared structures.
- The trans European transport network as a whole with new habits of users and citizens.
- Infrastructure: design, planning, materials and safety.
- New technical requirements of infrastructure node to reduce died-time.
- Project, design and development of new multimodal infrastructures, favouring the incorporation of new materials which decrease the risks upon natural hazards and favour the environment and study on the technical-economical reliability and feasibility of these new multimodal structures.
- Impulse of logistic transportation nodes which allow a quick exchange of transportation mean.
- Setting of multimodal centres allocated through the European Network system, and the coordination of these centres among them.
- The strengthening of means of transport which connect rural areas with the most important centres of population, mitigating the risk of marginalising the not so important risks.
Management

New information system between mode of transports
Risk and emergencies: possibilities of a partial functionality of the system.
New coordination requirements for exchanging information among infrastructure and operators
New ways to exchange goods and passengers among nodes
New exchange mode of information with artificial intelligence system.
Exchange of goods and passengers among modes
Study and implementation of new information means which promote the use of intermodality networks, allowing a quicker exchange of transportation.
Exchange of goods and passengers between urban and extra-urban environment
Exchange of information
Management of risk and emergencies
3 THE VISION FOR THE RAILWAYS SECTOR

3.1 BACKGROUND AND PRESENT POSITION

The situation is also critical for the railways sector, where the European Commission has stated that it wishes to see a large increase in the use of the European railway network in the coming decades.

A response to this challenge has been formulated in the Strategic Rail Research Agenda 2020 (SRRA) delivered by European Rail Research Advisory Council (ERRAC) on behalf of all major stakeholders in the European railway sector. According to the SRRA vision the railway shall become an important player in the European transport system by providing seamless, integrated high-speed passenger and freight rail services, as well as efficient and environmental friendly public transport in metropolitan and urban areas.

To support this vision ERRAC has developed a business scenario with a target of a large increase in rail transport. The target is set at twice the market share and three times the market volume of freight and passenger transport (in 2020 compared with 2000). This is an enormous challenge for the European railway sector.

The railway networks has only two major ways to respond to this challenge and those are to build new line capacity or find new methods for a radical increase in utilisation (capacity) of existing lines. Increased capacity of existing lines has to be a major target as it can be expected that building of new lines to cover a threefold increase in traffic volume is not economically feasible.

ERRAC expects that the capacity of existing networks can be doubled by using new signalling and train control systems, combined with improved production systems and capacity management.

Together with the envisaged trans-European dedicated high-speed network this should be enough to absorb the increase of the long/medium distance passenger traffic.

Also the increase in freight will then be possible to accommodate provided that the trans European rail freight network of around 15000 km of new and existing lines predominantly dedicated to freight will be established.

For urban transport ERRAC expects that the length of existing Light Rail systems will have to double in order to accommodate the transport demand as well as to increase the connectivity and geographical availability of the networks.

Other parameters decisive for transport capacity is train speed, train length, train weight (axle load) and loading profile. A very important factor for the total capacity is the availability of lines determined by maintenance procedures and effectiveness.

When all these technical challenges have been met the challenge for train operators is to become competitive enough to attract three times as much demand for rail services. One basic requirement for increased market shares is that railway services can be provided at a competitive price. Increased cost efficiency is therefore a requirement for both vehicle and networks operators.

Most challenges and research needs identified by the railway sector are described in the SRRA. The ECTP Rail Vision and SRA will therefore be a very important complement with the focus on design, construction and maintenance of trackbed, tunnels and bridges. Another important area to be addressed is the planning and design of new and upgraded infrastructure. These are all questions that need to be addressed in cooperation with the construction industry and which the railway has in common with other network infrastructure operators and especially with roads.

The European railway industry is a very large user of construction services, mainly for the maintenance and renewal of existing track, bridges, tunnels, retaining walls, stations and other buildings. The construction sector also plays an important role in the creation of the high-speed rail networks currently being built across Europe.

The organisation of the railway industry differs across Europe, from fully privatised to fully state controlled. In many cases directly employed staff undertakes physical maintenance and renewal works, but the construction of new lines is largely in the hands of the construction industry. As the physical separation of infrastructure ownership and maintenance from train operations accelerates, the construction industry will become more and more involved.
The challenge to the railway network operators together with the construction industry will therefore be to ensure that existing and new infrastructure can meet the demands of higher speeds and higher loads and that it at the same time can be maintained and renewed without unduly disrupting the traffic on the railway, or on roads that cross the railway by means of bridges or level crossings, without prejudicing the very high levels of safety currently enjoyed by the European railway network.

These challenges have to be met at the same time as increasing demands of cost effectiveness and environmental impact has to be fulfilled.

Another challenge for the railway network operators is to ensure that new and upgraded infrastructure has an optimum design in terms of meeting transport demands, availability aspects, intermodal aspects, land use and social impact.

These are the main areas for research and innovation that will be described in the ECTP rail SRA.

### 3.2 MANAGING THE ASSET

The European railway industry is a very large user of construction services, mainly for the maintenance and renewal of existing track, bridges, tunnels, retaining walls, stations and other buildings. The construction sector also plays an important role in the creation of the high-speed rail networks and freight corridors currently being built across Europe.

The organisation of the railway industry differs across Europe, from fully privatised to fully state controlled. In many cases directly employed staff undertake physical maintenance and renewal works, but the construction of new lines is largely in the hands of the construction industry. As the physical separation of infrastructure ownership and maintenance from train operations accelerates, the construction industry will become more and more involved.

Within the constraints of current railway funding, the construction of a large number of new lines is not feasible, so efforts will have to be concentrated on maintaining and upgrading existing assets. The challenge to the construction industry is to ensure that existing infrastructure can be maintained and renewed without unduly disrupting the traffic on the railway, or on roads that cross the railway by means of bridges or level crossings, without prejudicing the very high levels of safety currently enjoyed by the European railway network. This is one of the most important areas that needs to be addressed through new technological research and innovation.

This research priority sets out to achieve cost reductions for both newly built products and maintenance. Cost reduction for both manufacturing and running the railway technical system is an essential prerequisite for obtaining the vision. But this requirement is accompanied with requirements of high availability of both lines and vehicles, which implies high technical standards and quality. Innovation is needed to produce new high quality equipment at competitive costs, but as existing material has a rather long service life, the development of efficient maintenance methods is absolutely essential.

#### 3.2.1 VISION 2010, 2020, 2030

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<td>2030</td>
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3.2.2 FIELDS OF RESEARCH

Assessment methods and models
Technical design aspects for infrastructure such as calculation methods for structural performance in terms of static and dynamic strength, deterioration and life cycle prediction, models for assessment of soil properties etc.

Monitoring the performances
Technical methods for monitoring the performance of infrastructure to allow for optimization of maintenance activities

Materials
Possibilities to use new materials for improved functionality, longer life and lower costs

Construction techniques
Techniques for building, upgrading, repair and strengthening, maintenance and replacement of different components

Management
All aspects and methods for an optimal management of infrastructure maintenance – organization, administrative etc.

Improved methods for procurement of construction and maintenance of infrastructure

3.3 ENVIRONMENTAL IMPACT (SAFETY TOWARDS CITIZENS)

Although the rail sector already has a positive environmental image in comparison with other modes, the weight of public opinion is demanding that these advantages are improved. An area of particular concern is noise abatement. Another area of big concern to the railway industry is energy consumption, as energy costs has risen sharply the last couple of years.

It is also important that the railways potential to take an important role in the future sustainable society is investigated. This requires an holistic approach, where all aspects of sustainability are regarded. It is therefore important that the social costs for all aspects of environmental effects are evaluated objectively, as an input to the overall political planning and policy building processes.

3.3.1 VISION 2010, 2020, 2030

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3.3.2 FIELDS OF RESEARCH

Materials
Environmental friendly materials
Reuse of materials
Problems of ground and water pollution that are related to past and future infrastructure building and maintenance
Vibration and noise problems related to substructures, bridges and tunnels, which mainly are related to ground vibrations and ground and structure borne noise.
Weed control of railway substructure can have a large environmental impact and there is a need to develop more environmental friendly and cost effective methods.

System solutions
Life cycle assessment of infrastructure considering environmental impact and total energy consumption is an increasingly important factor when assessing new building, construction and maintenance techniques and procedures.
3.4 SAFETY AND SECURITY

Overall safety and security questions for railway are well described in SRRA, which main targets for research in this area are hazard reduction and continuous improvements of railway safety and security. An overall system approach is necessary, which covers a full analysis of interrelating elements and determination of risks involved.

Infrastructure specific safety and security questions relates to tunnels, level crossings, seismic risks and soil stability (landslides) as well as avalanches.

3.4.1 VISION 2010, 2020, 2030

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<th>Breakthrough/innovation</th>
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3.4.2 FIELDS OF RESEARCH

Security of demand

Passenger safety: In terms of infrastructure the passenger safety aspects treated here are mainly connected with evacuation of trains in tunnels in case of a break down or an accident, but the problem also has to be considered on bridges and on ordinary lines.

Dangerous goods: Dangerous goods is a risk factor both for people and nature. Urban areas and environmentally sensitive areas has to be considered specifically.

Security from natural hazards

Seismic risks: This research field is described in the Road SRA and is also relevant to the railway. Slope Stability

Stability of the substructure can be a problem in slopes and certain types of soft soil.

Avalanches: In certain European areas the risk for avalanches is a problem that has to be addressed.

Security from man made risks

Level crossing safety

Safety at level crossings is a problem which the railway have in common with the road sector and which mainly is treated with signalling techniques and shields. If this is a relevant subject in this SRA is unclear but should be investigated.
3.5 OPERATIONS AND INTEGRATION TO OTHER NETWORK

Interoperability and intermodality are both key factors for reaching the goals for the future European railway.

Increased interoperability requires harmonization of railway technical and administrative systems and is addressed for example in the TSIs (Technical Specifications for Interoperability) for high speed and conventional rail that recently have been approved by the member states.

Intermodality is an important factor for railway transports as the railway seldom reaches the end points of a specific transport.

Future transport demand, political policies and the legislative framework set the scene for the development of railway transport and intermodal exchange. Research is essential in order to understand the influence of policies and regulations and to validate the effects. By creating an extensive knowledgebase in these issues a better base for political decisions will become available.

The research should cover areas such as transport economics, socio-economics, political policymaking, legislation, roles and responsibilities, long-term strategies and planning for infrastructure investments etc.

The research area supports the development of the railway system to a well working system were each player have a well-defined role and strong incitements to develop a cost efficient and high quality organisation.

As intermodality requires close cooperation between the different transport modes, most of the research needs has to be defined in close cooperation between the transport modes.

3.5.1 VISION 2010, 2020, 2030

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3.5.2 FIELDS OF RESEARCH

Management

Future transport demand: Assessment of the future transport demand is an essential input to all planning of new upgraded infrastructure.

Effects of new and improved infrastructure: Methods for assessing and evaluating the effects of new and improved infrastructure on the demand for railway transport and for external environmental and social impacts

Planning methods: Methods for optimum planning of new railway infrastructure taking into account transport demand, availability aspects for passenger and freight, intermodal and interoperability aspects end external factors such as social impact.

Location of terminals for exchange between modes: The location and capacity of terminals is a crucial factor for intermodal transport

Conceptual solutions

Train length, weight and profile: Using longer trains, increased axle loads and weight per meter as well as increased loading profiles can increase the transport capacity of the railway. The full potential of such measures can only be obtained if they are made available across boarders. The possibility of intermodal transport is sometimes limited by the loading profile, as limited loading profiles sometimes makes it difficult to transport trailers or containers in a cost effective way.
The vision for the inland water ways

Coming soon
4 THE VISION FOR THE INLAND WATERWAYS

4.1 PRESENT POSITION IN THE INLAND WATERWAYS

A far as it concern the inland waterways transport, the Commission's drive for promoting waterborne transport ("Highways of the Sea") is strong in an attempt of balancing between transport modes to relieve most congested ones providing a way around bottlenecks, such as in the Pyrenees. Inland waterways transport is by far the most cost effective for goods transport compared to road and rail transport, when related to cost of exploitation and maintenance of the network. It has a strong potential in absorbing a substantial part of the expected growth in goods transport. The challenge is to improve the existing waterway network and invest in strategic extension from an overall network vision on transport. The large investments in the European water systems needed in near future to improve water management, give many opportunities in combining goals; effective water management and a boost for waterways transport.

On aspects safety, fuel efficiency and pollution inland water transport is capable to a high performance. Inland waterway transport has the potential to relieve (some of) the pressure from goods transport on the rail and road network. A synergy of revitalising existing waterways, strategic extensions and making use of the redesign of the European water systems can provide very competitive solutions.
A NETWORK OF UTILITIES

Vision 2010, 2020, 2030 and fields of research
- Gas
- Water distribution and sewerage
5 THE VISION FOR THE GAS SECTOR

The European natural gas network is and must continue to be a safe, integrated system, capable of coping with the vast quantities of gas that it transports and delivers in response to the demand from end-users. Within the timescale addressed in this ‘Vision’, the natural gas infrastructure must evolve toward a more flexible, more intelligent system that will:

- become cheaper to build and to run;
- be more durable, without compromising safety and security;
- deliver a longer lifetime;
- be capable of accepting a wider range of gases;
- be able to be detected and located more easily;
- be easier to inspect, maintain, repair, or replace;
- provide the services demanded by the variety of end-users;
- be able to be constructed, maintained, repaired or replaced with minimal disruption to traffic and to quality of life of those in the vicinity, and at minimal cost.
- become an acceptable neighbour from the point of view of environmental and security issues.

Three areas for research and innovation

1. Asset management
2. Environmental impact
3. Safety, security of supply & security

5.1 BACKGROUND AND PRESENT POSITION

As far as it concerns the gas industry, natural gas provides 23% of the European Union’s primary energy consumption and it is anticipated that this will grow to around 28% by 2020: the world’s proven natural gas reserves are estimated at some 70 years at current consumption levels.

With regards to security of supply, the European Union is fortunate to be so well placed, given the wide geographical dispersion of natural gas. The existing natural gas network, in Europe and beyond, whether pipeline or LNG based, has benefited significantly over the years, and will continue to benefit, form a rigorous approach to system design and management, based ultimately on sound R&D. This will be vital if the gas industry’s exemplary safety record is to be maintained and it’s clear that it will become increasingly important as the European gas industry broadens its supply base to ensure that the flow of natural gas into Europe continues.

The natural gas industry in Europe is going through a period of extraordinary change:

- Demand for natural gas is set to grow across Europe and the development of safe, well controlled, and reliable natural gas networks will be essential if customers are to achieve the maximum benefit;
- Increased emphasis is being placed on the development of integrated approaches to urban energy issues and to the identification of solutions which will enhance the well-being and quality of life of Europe’s citizens;
- There is an increasing requirements to address the problems associated with energy efficiency and emissions and, although natural gas is the preferred fossil fuel as it offers a clean and efficient energy source, there remains a demand for high quality R&D if further improvements are to be made;
- There is a requirement to deliver benefits to share holders in newly privatised companies which implies cost savings and, almost inevitably, this has meant significant reductions in R&D expenditure and an emphasis on payback in the shorter term.

Hydrogen is a major plank in the European Union’s bridge to security of energy supply on its way to the ‘Hydrogen Economy’ and it is likely that hydrogen will play a major role in bringing about clean energy conversion in the long term.

The European Gas Industry has an important strategic role to play as between supply and demand, there will be a need for a high quality, reliable pipeline network capable of delivering natural gas/hydrogen mixtures. Clearly the environmental advantages could be significant, with respect to the Kyoto targets, even if the distributed mixture contains no more than 20% hydrogen.
5.2 MANAGING THE ASSET

Natural gas currently provides 23% of the European Union’s primary energy consumption and it is anticipated that this will grow to around 28% by 2020\(^2\). As a consequence, owners and operators will experience considerable increases in the use of their networks in the coming years. They will only be able to respond to this challenge by building new infrastructure or by upgrading the existing infrastructure so that it can be used more effectively.

However, the construction of large numbers of new, high pressure, gas transmission pipelines is not feasible, so efforts will be concentrated on maintaining and upgrading existing assets by, for example, increasing the operating pressure. Much of the existing high pressure network will have to be used for the coming decades, which means that degradation mechanisms will have to be very well understood. Proof of pipeline integrity will be paramount and will demand new techniques for both inspection (especially for non-piggable lines) and rehabilitation.

In addition, many households still need to be connected to the gas network and, as a consequence, the low pressure gas distribution system will be progressively extended by means of new pipelines. Hence, there will be a continuing requirement for new technologies to enable the installation of new house connections and also for the repair and renovation of parts of the more than 1.2 million km of existing distribution pipes in Europe (EU15).

The challenge to the gas industry is to ensure that existing infrastructure can be inspected, maintained, repaired or renewed at minimal cost and with the minimum of disruption to traffic, quality of life and the environment, set against a background where safety is paramount.

These are all areas for which technological innovation, whether it be derived from new materials; new techniques; or information technology, is essential if advances are to be made and they all, therefore, very much depend on research and development activities.

5.2.1 VISION 2010, 2020, 2030

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<th>Objectives</th>
<th>Breakthrough/Innovation</th>
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<tbody>
<tr>
<td>2010</td>
<td>Design, development and application of new materials, monitoring systems, construction maintenance, renovation and replacement techniques capable of meeting increasing demand; extending lifetime; and reducing disruption to traffic and to citizens</td>
<td>Design, development and application of new materials, monitoring systems, construction techniques, maintenance techniques, renovation techniques, replacement techniques</td>
</tr>
<tr>
<td>2020</td>
<td>Design, development and application of management and operational tools for maintenance and renovation of gas networks to reduce costs, without compromising safety, security or the environment.</td>
<td>Design, development and application of management &amp; operational tools</td>
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<tr>
<td>2030</td>
<td>A safe, integrated pipeline system with increased longevity, capable of rapid maintenance/repair, with minimal disruption incorporating new materials, new technologies and capable of carrying a wide range of gases.</td>
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\(^{2}\) IEA
5.2.2 **FIELDS OF RESEARCH**

The following field of research have been identified as topics to be detailed in the Strategic Research Agenda.

5.2.2.1 **MODELING THE PERFORMANCE OF THE INFRASTRUCTURE**

Development of models to assess and predict the performance of pipeline structures subject to:
- variations in pipeline-soil interactions;
- pipeline ageing;
- increased loads, and;
- gas type and/or quality;
with the aim of extending life-time, with no reduction in safety.

5.2.2.2 **MONITORING THE PERFORMANCE OF THE NETWORK**

Development and use of the latest intelligent pigging to determine the integrity of pipelines.
Development of new sensors and techniques based on new materials and new technologies, such as: nanotechnology, for, for example, improved detection/condition-monitoring of existing lines.
Developments in sensor technology and techniques that will improve the capabilities and reduce the cost of remote sensing and telemetry.
Definition and implementation of a technological approach that will allow the maintainability and replacement of instrumentation at low cost.
The development of new, improved techniques for inspecting, assessing and rehabilitating existing pipelines.

5.2.2.3 **IMPROVING THE PERFORMANCE OF THE INFRASTRUCTURE: MATERIALS AND CONSTRUCTION TECHNIQUES**

**Materials**
New generation of materials suitable for future pipeline systems.
New materials that will enable reduced cost maintenance and repair, with enhanced performance whilst extending durability, with minimal impact as far as their practical application is concerned.
Development and use of the latest pipe coating materials and their application techniques.
Smart & high performance pipeline materials (e.g. multifunctional & adaptive materials, incorporating nano-structures.

**Construction/maintenance techniques**
Development of:
- more efficient techniques related to transmission pipelines, for installation; for rehabilitation of existing lines; for improved monitoring; for risk assessment;
- new techniques and technologies for construction, repair, maintenance, replacement, reinforcement, with the lowest impact on traffic and the environment;
- 'no-dig' techniques for construction and in-service inspection of gas distribution networks;
- new approaches to trenchless technology, to ensure minimal disruption and to minimise the use of natural materials;
- techniques for maintenance, repair or replacement which assure safety conditions and no interruption of service;
- robotic techniques for inspection and repair of distribution pipelines.
- accurate methods for locating existing assets.
- new techniques to minimise the size and cost of excavations and backfilling.
- new techniques that will enable integration of new utility networks (gas, water, sewer, electricity, etc.) in a single built infrastructure or duct.
- small-dimensioned trenching, with new, mechanised, laying techniques;
- low cost techniques for pipeline construction and maintenance including lifetime optimisation and material recycling.

### 5.2.2.4 Enhanced Management

Development, feasibility and application of new methodologies for operation and maintenance of high pressure transmission pipelines;

Development, feasibility and application of new methodologies for operation and maintenance of gas distribution networks.

Development, feasibility and application of models and tools for network integrity management for transmission and distribution networks.

Ensuring that the latest technologies and techniques are transferred to engineers and contractors so that they are well qualified to advise on the installation of new gas pipeline and distribution networks in rural, urban and congested areas.
5.3 ENVIRONMENTAL IMPACT (SAFETY TOWARDS CITIZENS)

Creating a global vision for the pipeline infrastructure of the future is aimed at selecting, in particular, environmentally friendly concepts which offer a compromise between reduced construction/maintenance costs and safety and environmental criteria. Within this, the sustainable use of resources, including the recycling of materials, are important.

Urban and suburban air quality is improving, but resident populations are still exposed to undesirable levels of vehicle-derived pollution. Vehicle technology has been effective in reducing transport emissions but a large number of people, particularly in urban and suburban areas, are still exposed to high pollution levels, and this will continue to be the case in future. There would be undoubted benefits to the environment, to quality of life, resource management and fuel efficiency from minimising the amount of street-works, related to buried infrastructure, taking place in cities and in rural environments. Consequently, more R&D funding targeted at developing the technologies to minimise street works disruption would have a considerable positive influence on air quality, traffic noise reduction and citizens’ state of mind (consider road rage). It’s must also be noted that this point applies to every utility: gas, water & sewerage, electricity and telecoms and, indeed, to all city administrations.

Areas where a clean, quiet atmosphere can be experienced are being progressively reduced by the increased density of urban areas and growing mobility and, whatever rules and regulations exist in Member States, the number of European citizens that are irritated by environmental noise or have their air polluted by traffic congestion shows an ever growing tendency. In this context, it must be noted that, in the U.K. alone, road traffic is predicted to grow by 50% between 1996 and 2030.

If we consider the long-term environmental picture and the vision for a ‘Hydrogen Future’ for Europe, it will be important to ensure that there will be suitable networks for the transport of gaseous hydrogen. The Gas Industry is the best qualified to determine the problems and solutions associated with this initiative and, given support for appropriate R&D, can therefore make a significant contribution to the EU’s environmental aspirations.

Existing pipelines will have to be modified and/or new pipelines will have to be built, with minimal disturbance to the living environment and this will require extensive investigation, extensive safety modelling and testing and development of new construction techniques.

### 5.3.1 VISION 2010, 2020, 2030

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<tr>
<td>2010</td>
<td>Development of new techniques and equipments for more efficient street works</td>
<td>Development of &lt;li&gt;new techniques&lt;/li&gt; &lt;li&gt;equipment&lt;/li&gt;</td>
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<td></td>
<td>Improved materials and technical solution to reduce impact and negative effects (noise, pollution, etc.) on users and communities due to transport congestion from street works</td>
<td>Improved /new &lt;li&gt;materials&lt;/li&gt; &lt;li&gt;technical solutions&lt;/li&gt;</td>
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<tr>
<td>2020</td>
<td>Optimisation of new materials and technical solutions to reduce impact and negative effects (noise, pollution, etc.) on users and communities due to transport congestion from street works</td>
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<tr>
<td></td>
<td>Optimisation of new generation of equipment for rapid, accurate location, installation/maintenance of pipelines with minimum disruption to citizens and traffic</td>
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<tr>
<td>2030</td>
<td>Radically innovative approaches to gas network installation, maintenance and repair which minimise environmental impacts on communities. Very high percentage of ‘no-dig’ interventions.</td>
<td>Innovative techniques and technologies to ensure maximised recycling (&gt;50%) and re-use of materials to ensure significant reductions in the consumption of natural resources.</td>
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3 U.K. Transport Research Laboratory
5.3.2 FIELDS OF RESEARCH

The following field of research have been identified as topics to be detailed in the Strategic Research Agenda:

5.3.2.1 ENVIRONMENTAL IMPACT

Design for environment (including cost/effectiveness performance analysis) to integrate innovative systems solutions

New, low impact techniques for construction, maintenance, repair or renewal, including new maintenance and back-fill re-cycling techniques and the integration of composite materials to minimise environmental pollution.

Development of techniques and technologies to enable small-dimensioned trenching and new, mechanised, network installation techniques – for security, for reduction of disruption, pollution, working time and cost.

Development or improvement of technologies, such as Ground Penetrating Radar (GPR) and trenchless (no-dig) technologies, for reducing the size and duration of street works, minimising the volume of transported soils and increasing the quality of life by minimising problems associated with urban traffic problems.

New techniques/materials for installation, operation, repair and maintenance which reduce the environmental impact (e.g. repairing without loss of gas).

Development of new excavation techniques that allow recycling and re-use of materials, with the aim of substantially reducing the consumption of natural resources.

Development of new construction techniques to reduce noise emission in specific installations, such as compressor stations and MRS.

Design and application of new technologies to reduce gas venting to the atmosphere.
5.4 SAFETY, SECURITY AND SECURITY OF SUPPLY

These three, closely intertwined issues, which have long been priorities for owners and operators, and are now exercising the offices of the EU. It’s clear that continued R&D will be vital if the gas industry’s exemplary safety record is to be maintained and that it will become increasingly important as the European gas industry broadens its supply base to ensure that the flow of natural gas into Europe continues.

5.4.1 SAFETY

Safety is of prime concern in the gas industry and, in general, it’s true to say that the European gas industry has an exceptional safety record. With the exception of the recent tragic incident in Belgium, in the last decade the overall frequency of incidents causing an unintentional gas release has gradually reduced demonstrating the success of an increasing integration of safety in the total pipeline process; i.e. proper design and construction (including pipe manufacture), adequate maintenance, and safe operation. But, however well built and maintained gas pipelines Third Party Interference (TPI) is still the greatest cause of incidents on gas pipelines. As a result of information technology, it’s increasingly possible these days to get information more quickly regarding the effectiveness of measures to increase the safety performance of (high pressure) gas transmission systems and this technology development must be continued to reduce even further the incidence of TPI in the gas industry.

Most of the existing high pressure network in Europe will continue to be used for the coming decades, which means that degradation mechanisms will have to be very well understood. Proof of integrity of pipelines will also be essential and will demand new inspection techniques (especially for non-piggable lines) and rehabilitation techniques.

5.4.2 SECURITY OF SUPPLY

Of course, security of supply is paramount because, as society becomes more dependent on gas, there will be a corresponding increase in the expectation that disruptions must be avoided and that repairs, rehabilitation and maintenance of pipelines will have to be done without compromising the supply.

With regard to security of supply, the European Union is fortunate to be so well placed, given the wide geographical dispersion of natural gas. However, it needs to be understood that in future years Western Europe will become increasingly dependent on gas coming from Russia & the NIS and it is anticipated that the problems, whether political, geological or pipeline quality related in these countries are different from, and often more severe than, those in the EU. As a consequence, security of supply becomes an extremely important issues and it will be vital for those involved to address the relevant issues together, to ensure a secure, continuing delivery of natural gas into Western Europe.

5.4.3 SECURITY

In recent times, security has acquired a considerably higher profile as a result of world events and societal changes. Europe needs to invest in this area in order to address, effectively and innovatively, existing and future security challenges (including natural and external risks].

Development and use of innovative technologies are the key to safe and efficient pipeline construction and operation. It’s important to note that the existing European natural gas network, whether pipeline or LNG based, has benefited significantly over the years, and will continue to benefit, from a rigorous approach to system design and management, based ultimately on sound R&D.

The following issues, which apply to the three above categories, are also relevant elsewhere in this document, are likely to be more severe in countries outside the EU and, as a consequence, new technological developments will be essential to:

- prevent/detect Third Party Interference, whether accidental or malicious;
- detect natural gas emissions;
- monitor for landslides and subsidence;
- control corrosion and material defects.

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4 EGIG - European Gas Pipeline Incident Data Group
5.4.4 VISION 2010, 2020, 2030

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<td>2010</td>
<td>To identify, implement and integrate solutions (development of tools, materials, techniques, models, ICT) that increase safety and security and reduce the risks for users and citizens from external and natural hazards</td>
<td>• definition of the needs of the operators in terms of management and operational impact.</td>
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<td>• verification of the technical and economic feasibility of the technological solutions available or under development.</td>
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<td>• definition of a plan or roadmap to apply new technologies;</td>
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<td>• evaluation of impact on users, to reduce costs</td>
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<td>• protecting against natural hazards</td>
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<td></td>
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<td>• protecting against Third Party Interference (TPI)</td>
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<td>• protecting against terrorism (detection; protection-neutralisation).</td>
</tr>
<tr>
<td>2020</td>
<td>Optimise the use of solutions (tools, materials, techniques, models, ICT, etc) that increase safety and security and reduce the risks for users and citizens from external and natural hazards</td>
<td>Optimisation of safety, security and protection of networked systems. utility</td>
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<td>Continual anticipation and re-assessment of vulnerabilities-interdependencies,</td>
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<td>2030</td>
<td>An integrated pipeline protection system incorporating e.g. remote monitoring, inspection, telemetry and communication to achieve optimum levels of:</td>
<td>• security;</td>
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<td></td>
<td></td>
<td>• safety of networked systems, and;</td>
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<td>• to ensure security of supply into the EU.</td>
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5.4.5 FIELDS OF RESEARCH

The following fields of research have been identified as topics to be detailed in the Strategic Research Agenda:

5.4.5.1 SAFETY AND SECURITY

Development of models and tools for risk and safety management, integrating issues such as safety culture, roles and responsibilities, training and competency, quality and performance management, etc. which ultimately have a major impact on the safety of operations.

Development of models, materials, monitoring systems, components, design and construction techniques able to:

• have a better understanding of material and network degradation mechanisms;
• predict, measure and prove pipeline integrity;
• develop new inspection techniques (especially for non-piggable lines);
• detect and reduce the vulnerability of pipeline networks to natural hazards (e.g. landslides) to guarantee the safety of the network.

Development of the techniques and technology to enable the physical adaptation of pipeline infrastructure by using, for example, smart materials/devices or interactive infrastructures with (evolving) self-knowledge

Develop new design models and techniques for gas networks which are less vulnerable to incidents, failures etc.

Design to reduce risks, with developments of tools for:

• risk modelling
• risk perception

Development of integrated sensor technologies and communication and information technologies for real-time control of network operations ("smart utility concept")
6 THE VISION FOR THE WATER DISTRIBUTION AND SEWERAGE

6.1 BACKGROUND AND PRESENT POSITION

As far as it concerns the waterways sector (water and drainage systems), the worldwide market for water and waste water amounted to more than €250 billion in 2002, the anticipated overall growth rate of 18% by 2005 and 60% by 2010. The World Bank has ongoing commitments of about €17 billion in water projects. The EIB loans for water and sanitation projects, more than 300, totalled about €8.3 billion over the last 5 years.

The European water sector is a major economic player (1% of the EU15 GDP) that generates many positive impacts from a social and economic perspective (e.g. 0.8% of the total EU employment). In the recent years, the turnover of this sector (about €80 billion in the EU) grew by an average of 5% per year compared to 2.5% for the average growth of the economy. Also employment in this sector grew faster than the turnover, at a rate between 6 and 7% per year. To some extent this rate of growth has been lead by the increase in European water and environmental legislation, such as the Urban wastewater Treatment Directive, and the drinking Water Directive. Current legislative developments indicate that this growth rate is unlikely to reduce, Water Framework Directive, Groundwater Directive

International markets have been explored and penetrated successfully by some of the major European water industries, a position that should be strengthened and consolidated. It is expected that if the trend of liberalisation, concentration and globalisation in this sector will continue, less than 20 large undertakings will dominate 50% of the world water market by 2015.

The European water industry is competing in a worldwide market where the major criteria for success are finance, technology portfolio, and internationalisation. The European water industry has succeeded till now to preserve its position in the world market arena. However, to face future challenges, additional efforts and investments in research are required to foster international competitiveness. Developments of new and cost-effective technologies are vital in the water market, which is increasingly considering and integrating environmental externalities and energy aspects.

Water policy is a large part of European environmental legislation. In particular the coming deadlines in respect to the Urban Waste Water Directive and the implementation of the Water Framework Directive will necessitate considerable investment in EU and Acceding Countries water sectors. However the links between EU water related policy, research and civil society must be strengthened rapidly to reconcile the sometimes competing objectives of decision-makers, scientific community, industry and consumers.

Today’s water system was conceived centuries ago and expanded rapidly as a result of urbanisation following the industrial revolution, but has a history of slow technological adaptation. The growth of the world population and the growing degradation of clean freshwater resources make this system not sustainable for the world of tomorrow. Climate change is dramatically worsening the future scenarios.

Collection of water and removal of sewage is essential for the maintenance of public health and the supply of industry. Although largely unseen and unnoticed, the networks, consisting of millions of kilometres of pipes supply millions of litres of clean water to properties across Europe and collect millions of litres of sewage.

The water and sewerage system needs to work as an integrated delivery and collection system which contributes to the supply of fresh, clean, safe, water at the point of use and the collection and disposal of used water to optimise use of this scarce resource, protect public health and meet the demands of users.

Therefore the water and sewerage network must evolve from two sets of unresponsive pipe networks to an intelligent infrastructure that can monitor and control the quality and quantity of the product it is transporting as well as the health of the network itself.
6.2 MANAGING THE ASSET

Throughout Europe countries are experiencing problems with an ageing infrastructure. Much of this infrastructure is over 100 years old and was installed without accurate records being maintained. This means that the asset location is often not accurately known. In addition basic data such as the age or material of the pipe, essential for estimating with any accuracy the likely risk of failure may also be missing. Leakage from the mains network in some countries amounts to 50% of the total water produced and methods of locating minor failures in water mains cannot always be relied upon to be accurate.

Current repair and renovation methods are intrusive and constrained by factors such as the presence of other utility apparatus, the need for side connections, the surrounding geology etc. It often requires substantial vehicle movements during work to remove excavated material and import new road fill. New infrastructure is being installed continuously and it is imperative that future installation techniques ensure that future maintenance approaches can be optimised.

Therefore there are four main problems which need to be addressed:

- Develop accurate methods for locating and identifying the nature and condition of existing assets
- Develop accurate methods for predicting future life spans and costs of assets and failure locations and modes.
- Develop new techniques for maintaining and renewing infrastructure with the minimum of disruption to traffic and pedestrians and the minimum impact on the environment
- Develop new methods of installing new apparatus that ensures that future whole life costs of the infrastructure are minimized.

6.2.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
<th>Breakthrough/Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Design, development and application of new technology within pipes to extend the life cycle of pipes, meet new standards, reduce disruption and maintain levels of service.</td>
<td>Design, development and application of new technology</td>
</tr>
<tr>
<td></td>
<td>Design, development and application of new materials, construction and renovation techniques to reduce consumption of natural resources and allow recycling and reuse of used materials</td>
<td>Design, development and application of new materials construction and renovation techniques</td>
</tr>
<tr>
<td></td>
<td>Design, development and application of management and operational tools to assure optimal use, lower impact on other networks particularly roads, extended life, optimal use of economic funding</td>
<td>Design, development and application of management &amp; operational tools</td>
</tr>
<tr>
<td>Horizon</td>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>Optimisation of the application of new materials, construction and renovation techniques able to meet increasing demand, reduce consumption of natural resources and allow recycling and reuse of used materials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optimisation and upgrading of management and operational tools to allow prediction of failure, reduced impact on other networks particularly roads, extended life, reduced whole life costs.</td>
<td></td>
</tr>
<tr>
<td>Horizon</td>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>Integrated water mains and sewer systems with increased longevity and reduced whole life costs, capable of rapid maintenance and repair with minimal disruption incorporating new materials and technologies and ensuring minimal leakage/ingress.</td>
<td></td>
</tr>
</tbody>
</table>
6.2.2 Fields of Research

The following fields of research have been identified as topics to be detailed in the Strategic Research Agenda:

6.2.2.1 Modelling the Performance of the Infrastructure

Develop models to assess and predict the performance of pipeline structures over time subject to:

- Variations in pipeline-soil interactions
- Pipeline ageing
- Increased external loads
- Changing weather patterns
- Different water and sewage qualities

The aim is to extend the lifetime of the pipeline and reduce the need for interventions, particularly those which are unplanned, as well as reduce losses and ingress from the pipes.

6.2.2.2 Monitoring the Performance of the Network

Develop new sensors and techniques which could locate, identify and monitor performance of buried infrastructure, both via internally inserted and externally located sensors

Develop new sensors and techniques based on new technology such as nano-technology for e.g. improved detection/condition monitoring of existing pipelines.

Define and implement new technology that reduces the cost of maintenance and replacement of infrastructure such as key hole access repairs.

Develop new, improved techniques for inspecting, assessing and rehabilitating existing pipelines.

6.2.2.3 Improving the Performance of the Network: Materials and Construction Techniques

Materials

Develop a generation of new materials and composite materials which will reduce whole life cycle costs of pipeline of assets

Develop new materials which will reduce the cost of maintenance and repair with enhanced performance whilst extending durability

Develop technique which can be applied to existing pipelines to extend their lifetime and reduce repair requirements

Develop smart and high performance pipeline materials such as multifunctional and adaptive materials incorporating nano-structures.

Construction/maintenance techniques

Develop more efficient technologies related to transmission pipelines for installation and rehabilitation, monitoring and risk assessment

Develop new techniques and technologies for the installation, repair, maintenance, reinforcement and replacement with the lowest impact on traffic and the environment.

Develop no-dig techniques for construction and in-service inspection of water and sewerage networks.

Develop new approaches to trenchless technology, to ensure minimal disruption and minimise the use of materials

Develop techniques for maintenance, repair and replacement with no interruption of service and no compromise of public health

Develop new techniques to minimise the size and cost of excavations and backfilling

Develop small-dimensioned trenching with new mechanised laying techniques
6.2.2.4 Enhanced Management

Develop, test and apply methodologies for the optimal management of maintenance with minimal impact on service.

Develop, test and apply methodologies for the optimal operation of water distribution and sewerage networks.

Develop models and tools for risk management integrating such issues as safety, business processes, roles and responsibilities, training and competency, quality and performance management, etc.

Ensure that the latest techniques are understood and used by pipeline owners, engineers and contractors.
6.3 ENVIRONMENTAL IMPACT (SAFETY TOWARDS CITIZENS)

Creating a global vision for the water distribution and sewerage infrastructure of the future is aimed at using environmentally friendly approaches in order to balance reduced whole life costs, safety and security of service and environmental criteria. Within this, the sustainable use of resources, including recycling of materials where appropriate is important.

Urban and suburban air quality is improving, but resident populations are still exposed to undesirable levels of vehicle-derived pollution. Street works increase this exposure by leading traffic delays. In addition, more traffic movements are needed to bring workers, materials and plant to the site and to remove excavated material.

There will be undoubted benefits to the environment, to quality of life, resource management and fuel efficiency from minimising the amount of street works related to buried infrastructure, taking place in cities and rural environments. Consequently more R&D funding targeted at developing the technologies to minimise street works disruption would have a considerable positive influence on air quality, traffic noise reduction and citizens’ state of mind (consider road rage). It must also be noted that this point applies to every utility; gas, water and sewerage, electricity and telecoms and, indeed to all city administrations.

6.3.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
<th>Breakthrough/Innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>New materials and technical solutions for more efficient street works</td>
<td>Development of:</td>
</tr>
<tr>
<td></td>
<td>Improved materials and technical solutions to reduce impact and negative effects (noise, pollution etc.) on users and communities due to transport congestion from street works</td>
<td>● new techniques</td>
</tr>
<tr>
<td></td>
<td>Assessment of current technologies and materials available for their environmental impact</td>
<td>● equipment</td>
</tr>
<tr>
<td></td>
<td>Awareness raising of the impact of street works on the environment and opportunities available for reducing that impact</td>
<td>● materials</td>
</tr>
<tr>
<td></td>
<td>Improved understanding and knowledge</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>Optimisation of new materials and techniques to reduce impact and negative effects (noise, pollution etc.) on users and communities due to traffic congestion from street works</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optimisation of new generation of equipment for rapid, accurate location, installation/maintenance of pipelines with minimum disruption to citizens and traffic.</td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>Radically innovative approaches to water and sewerage network installation, maintenance and repair which minimise environmental impacts on communities. Very high percentage of ‘no-dig’ interventions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Innovative techniques and technologies to ensure maximised (&gt;50%) recycling and re-use of materials to ensure significant reductions in the consumption of natural resources.</td>
<td></td>
</tr>
</tbody>
</table>
6.3.2  FIELDS OF RESEARCH
The following fields of research have been identified as topics to be detailed in the Strategic Research Agenda:

6.3.2.1 ENVIRONMENTAL IMPACT
Evaluate indirect e.g. social costs as well as direct costs of construction and identify financial, structural and other changes to ensure that allowance for this can be made to encourage solutions to be chosen which minimise environmental impact.
Design which takes the environmental impact into account to deliver cost effective, high performance techniques.
New low impact techniques for construction, maintenance, repair and renewal including new maintenance and back fill recycling techniques and the integration of composite materials to minimise environmental pollution.
Develop techniques and technologies to enable small dimensioned trenching and new mechanised network installation techniques to reduce disruption and pollution as well as costs and working times.
Develop or improve technologies such as Ground Probing Radar and trenchless techniques to reduce the size and duration of street works, minimise the volume of transported soils and increase the quality of life associated with urban traffic problems.
Develop new pipe materials using renewable resources.
Minimisation of failures of sewers and leakage from mains to minimise environmental impact.
Develop techniques to reduce the consumption of natural non-renewable resources, reduce the impact on the environment and reduce construction time.
6.4 SAFETY, SECURITY AND SECURITY OF SUPPLY

The public water supply reaches virtually all people within the European Community. It has been the greatest contributor to public health of all time. However, it could also be the greatest spreader of disease and contamination. It is essential that public confidence in the water supply is maintained and therefore the safety and security of the distribution network, covering as it does, thousands of kilometres across Europe, must be maintained.

Security has recently come to the fore as a global challenge due to world events and societal changes. Europe needs to invest in this field in order to effectively and innovatively address existing and future security challenges (including natural and external risks).

6.4.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
<th>Breakthrough/Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>To identify, implement and integrate solutions (development of tools, materials, techniques, models, ICT) that increase the security of the distribution network and reduce the risks for users and citizens form external and natural hazards</td>
<td>• definition of the needs of the operators in terms of management and operation impact; • verification of the technical and economic feasibility of the technological solutions available on the market or under implementation; • definition of a plan or roadmap to apply this technologies, • evaluation of impact on the users, to reduce the costs • raising awareness • protecting against terrorism (detection protection-neutralisation), • protecting against natural hazards</td>
</tr>
<tr>
<td>2020</td>
<td>Optimise the use of solutions (tools, materials, techniques, models, ICT etc.) that increase safety and reduce the risks for users and citizens from external and natural hazards</td>
<td>Optimise safety, security and protection of the network</td>
</tr>
<tr>
<td></td>
<td>Continual anticipation and reassessment of vulnerabilities and interdependancies</td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>An integrated pipeline protection system incorporating e.g. remote monitoring, inspection, telemetry and communication to achieve optimum levels of security and maintenance of a safe supply of water.</td>
<td></td>
</tr>
</tbody>
</table>

6.4.2 FIELDS OF RESEARCH

The following fields of research have been identified as topics to be detailed in the Strategic Research Agenda:

6.4.2.1 SAFETY AND SECURITY

Develop sensor technologies, communications and information technologies for real time monitoring and management of networks.

Incident management:
- Early identification of incidents so alternative supplies can be identified to ensure that clean water is always available to both domestic and commercial consumers
- Suitable management and operative processes to deal with emergencies to speed up remediation operations and restore water supplies and sewerage.

Management of access: Identify means to ensure that security of the system is assured whilst affording easy access to the system for authorized users.

Risk management: development of risk assessment systems, models, materials, monitoring systems, components, design and construction techniques able to reduce vulnerability of structures to man made and natural hazards (e.g. earthquakes) to guarantee the functionality of the network.
6.5 INTEGRATION WITH OTHER NETWORKS

There is a need to push our civil infrastructure systems to higher levels of efficiency and competitiveness to be combined with the need to ensure minimum levels of service, reliability, and security, even under critical conditions. In order to do this, each utility and transportation network cannot be considered in isolation. For a true achievement of the minimum total cost and environmental impact, the installation, maintenance, repair and replacement of utilities needs to be considered as a whole along with any transportation systems for which the utility route is also used.

The current approach of utilities all using the roads and pavements as a corridor for their apparatus, can lead to unnecessary road congestion when an intervention is required as well as the need for the use of resources to repair the road, whose lifetime will have been shortened by the intervention.

Exchange of utility information can be problematical such that trial holes are often still needed to identify exactly where other utilities are located. Even with this precaution, third party strikes on utility apparatus are commonplace through much of the European Union. Although the costs are often hidden through being covered by insurance, this is a wasted cost to the community. There is a need to investigate and introduce new approaches to providing utility networks which takes the overall impact and the need for future interventions in to account.

6.5.1 VISION 2010, 2020, 2030

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>A more co-operative approach to installing, maintaining, repairing and replacing utility infrastructure</td>
</tr>
<tr>
<td></td>
<td>Understanding of the whole costs associated with utility networks which consider the affect on the road pavement, road users and other utilities</td>
</tr>
<tr>
<td></td>
<td>Improved technical solutions to reduce impact and negative effects on other utilities and the road network.</td>
</tr>
<tr>
<td></td>
<td>Assessment of current technologies and approaches available which the overall costs and impact on roads and other utilities.</td>
</tr>
<tr>
<td></td>
<td>Awareness raising of the impact of street works for one utility on other utilities and the road and opportunities available for reducing that impact</td>
</tr>
<tr>
<td>2020</td>
<td>Optimisation of techniques to reduce impact and negative effects on other utilities and roads</td>
</tr>
<tr>
<td></td>
<td>Extension of Multi-utility solutions to installation</td>
</tr>
<tr>
<td>2030</td>
<td>Radically innovative approaches to the design and installation of utility networks, which facilitates future access and minimises the impact on roads surfaces and users</td>
</tr>
</tbody>
</table>

6.5.2 FIELDS OF RESEARCH

The following fields of research have been identified as topics to be detailed in the Strategic Research Agenda:

6.5.2.1 INTER-OPERABILITY AND INTER-MODALITY

Develop new approaches to the exchange of information about assets to ensure that any intervention has the minimum impact on other utility apparatus

Improve co-ordination of works to reduce the overall number of interventions required in any location

Develop better forms of regulation of entry for utilities and highway authorities

Understand the true impact of utility interventions on adjacent utility apparatus and the road structure whole life cost

Management of risk and emergencies of using e.g. combined tunnels or service ducts:

New concepts of multi modal infrastructure design and design of new housing and business developments for optimal use of utility and transport infrastructure and shared structures
The overall Strategic Research Agenda
7 TRANSPORT AND UTILITIES: AN EUROPEAN ASSET

Guarantee functional networks and services responding to the needs of users and clients by balancing the need of new constructions against the need of preserving the patrimony by adopting solutions, techniques and materials that extend the life-cycle, increase capacity and durability, preserve rare resources with low impact on operation and with high standards of safety and security

7.1 INTRODUCTION
Infrastructural systems represent a huge public investment and are essential to the economic and social well-being of society. Infrastructure is expected to provide reliable service for very long periods of time, spanning several generations during which society will experience dramatic changes in terms of available technology, as well as individual and collective aspirations with regard to life quality indices.

There is increasing economic and political pressure to extend the life of existing facilities not only in order to save on the cost of replacement but also to avoid the high indirect costs associated with disruption of the transport, energy, commerce and communication networks that these facilities underpin, and to preserve rare resources and the environment.

Generally, infrastructure systems comprise structural components and assemblies as well as mechanical and electrical equipment. In contrast to the latter, the former are often more difficult to inspect, repair or replace, and their assessment involves processes which are subject to considerable variations resulting from limited knowledge, variable levels of experience and judgement, and subjective evaluations of the factors that may lead to unacceptable performance.

An integrated holistic approach is needed in order to understand and quantify the effect of complex technological, environmental, economical, social and political interactions on the life-cycle performance of civil infrastructure systems. Concerted effort is required on many different fronts, including materials, construction and maintenance techniques, structural analysis and simulation, risk and reliability, information technology, life-cycle and systems engineering.

Within the constraints of current funding, the construction of a large number of new infrastructur e of transport and service is not feasible, so efforts will have to be concentrated on maintaining and upgrading existing assets.

The challenge for all network operators is to ensure that existing infrastructure can be inspected, assessed, maintained, repaired or renewed at minimal cost and with the minimum of disruption to traffic, quality of life and the environment, set against a background where safety of users and workers is paramount.

7.2 TARGETS FOR 2030 AND KEY PERFORMANCE INDICATORS
Infrastructural systems of transport with expected longer service life integrating the most advanced solutions in terms of models, materials and recycling, monitoring and control systems, components, design, construction, and maintenance and replacement techniques.

Transport infrastructure with a reduced impact on the environment and territory

Transport infrastructure with a reduced impact on users and citizens

A safe, integrated pipeline system with increased longevity, capable of rapid maintenance/repair, with minimal disruption incorporating new materials, new technologies and capable of carrying a wide range of gases.
Radically innovative approaches to gas network installation, maintenance and repair which minimise environmental impacts on communities. Very high percentage of ‘no-dig’ interventions
Integrated water mains and sewer systems with increased longevity and reduced whole life costs, capable of rapid maintenance and repair with minimal disruption incorporating new materials and technologies and ensuring minimal leakage/ingress
Highly efficient management and operation of networks, with the use of the latest technologies, to reduce costs, without compromising safety, security and the environment
Competitiveness of the industry
Safety of workers

**Performance indicators**

*Reduction in service failures and mitigation of consequences*
*Reduction in number of accidents and mitigation of consequences*
*Reduction in number, size and duration of maintenance interventions (congestions and interruptions)*
7.3 RESEARCH AREAS

7.3.1 MODELLING THE PERFORMANCE OF THE INFRASTRUCTURE

1. Development of models
   - To assess and follow the properties and performance of structures and infrastructural components and parts (bridges, tunnels, foundations, embankments, pavements, pipelines, water mains and sewers, etc) over time to keep into account their transformation and deterioration with the aim of extending their life cycle
   - To predict the answer of infrastructural systems and components, to extend their life time and increase capacity with no reduction in safety and a positive impact on maintenance
   - To predict the response of structures and components to increased demand (volumes and intensity of traffic, gas and water type and/or quality, etc) as well as to increased seismic and other natural hazard actions
   - To describe demand patterns, volumes and intensity
   - To describe the properties of soils under increasing loads and with the aim of reducing impact on maintenance
   - To assess and predict the performance of pipeline structures over time subject to: variations in pipeline-soil interactions, pipeline ageing, increased external loads, changing weather patterns and different water and sewage qualities or gas type and/or quality.

2. Assessment of the modification of the structural performance of structures subject to ageing and increased loads: from deterministic to fully probabilistic models of deteriorated structures

3. Development of assessment standards on European level for structures

<table>
<thead>
<tr>
<th>Route/line network</th>
<th>—Models to predict the answer of infrastructural systems &amp; components, to extend their life cycle and increase capacity with no reduction in safety and a positive impact on maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>—Virtual representation of networks</td>
</tr>
<tr>
<td></td>
<td>—Application of ICT to store and classify data and information (DB)</td>
</tr>
</tbody>
</table>

| Structural system  | —Development of models to assess and follow the performance of structures over time |
|--------------------|—Life cycle costing |
|                    | —Development of standards |
|                    | —Virtual representation of structures |
|                    | —Application of ICT to store and classify data and information |

| Component | —Assessment of the modification of the structural performance |
|-----------|—Development of models to describe and predict demand |
|           | —Impact of demand on structural component |
|           | —Life-cycle costing |

| Sub-component | |
|---------------| |
7.3.2 Monitoring the Performance of the Network with a Positive Impact on Safety, Life Cycle Durability and Maintenance

1. Risk based inspection regimes for low impact on demand and costs
2. Improvement and/or development of:
   - Non-destructive, automated and scanning non-destructive inspection techniques for reliable assessment also of non-accessible elements to minimise impact on traffic
   - Techniques or combination of techniques for inspecting (for example ground penetrating radar) assessing and rehabilitating utility infrastructure
   - Development of NDT methods for quality control during construction processes
3. New systems of measure of significant parameters and definition and integration of the minimal set of significant data
4. Development of sensors and techniques and transmission systems (via ICT) able:
   - Based on new technology such as nano-technology for e.g. improved detection/condition monitoring of existing infrastructures
   - To locate, identify and monitor the performance of buried infrastructure, both via internally inserted and externally located sensors.
   - To guarantee a multifunctional approach.
   - To improve the capabilities and reduce the cost of remote sensing and telemetry.
5. Integration of monitoring, materials and components
6. Development of monitoring systems:
   - For use into daily operation activities and during construction and maintenance. Maintainability and replacement of instrumentation at low cost.
   - For long-term control by integration in asset management strategy and decisions
   - For life-cycle prediction by integration in models to evaluate future maintenance needs
7. Development of models that take into account the significant phenomena that describe the performance of structures (bridges, pavements, embankments)
8. Development and establishment of European databases and unification of instruments and training of personnel

<table>
<thead>
<tr>
<th>CIS</th>
<th>Full exploitation (and upgrading) of new testing techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full integration of sensing and communication technologies in</td>
</tr>
<tr>
<td></td>
<td>CIS (design, production &amp; will be real-time monitoring-based)</td>
</tr>
</tbody>
</table>

| Route/line network | New sensory systems for the infrastructure environment and |
|                   | Management Network based on the Internet |
|                   | Integration over large geographical networks |
|                   | Integration of SHM |
|                   | Decision Support Systems |

| Structural system | Monitoring-aided construction techniques |
|                  | Cost, fitness for purpose, size reduction, attachment and |
|                  | accessibility of sensors |
|                  | Wireless and networked sensor systems (ICT) |
|                  | Self performance monitoring by intelligent components and instruments |
|                  | Testing on infrastructure |

| Component | Smart structural prefabricated elements. |
|          | New testing techniques |
|          | Integration of materials, components and sensors |

| Sub-component | Increased knowledge |
|               | Smart layers/subcomponents to be employed in retrofitting |
|               | Novel measuring technologies (i.e. wireless) and SW development |
|               | New sensory systems for measuring physical/chemical parameters |
|               | Data fusion and data processing, SSI, etc |
7.3.3 IMPROVING THE PERFORMANCE OF THE NETWORKS

1. Development of new materials or enhancement of the performances of traditional existing ones:
   - To reduce maintenance and operation costs with low or zero impact on service and mobility
   - To improve durability
   - To resist environmental aggression
   - To reduce environmental impact
   - To increase use and re-use of recycled materials
   - To increase comfort of users and citizens

Materials might include, non exhaustively: concrete, bituminous materials, composite materials, multifunctional and adaptive materials, microbial enhanced materials, waste material or industrial by product, recycled materials, soils, coatings, pavements, smart and high performance pipeline materials such as multifunctional and adaptive materials incorporating nano-structures etc.

2. Design, build and operate:
   - With new or non-conventional materials of multifunctional characteristics
   - With traditional existing materials of enhanced performances

3. Development of technologies, fast and long lasting techniques, treatments and procedures for construction, repair and maintenance, upgrading, replacement:
   - With low or zero impact on service and mobility
   - With low cost and life cycle optimization
   - Able to reduce the number of interventions and time for carrying them out in safety conditions
   - With increased safety of workers
   - With industrialization of components
   - Using precast solution and element with value added service for demand management
   - With low impact on the environment (i.e. repairing with no loss of gas)
   - With reduced construction and installation time (including equipment), i.e. no-dig or trenchless interventions for pipelines

These items will include: road components such as bridges, tunnels, embankments, pavements, roads and highways arteries, transmission lines and distribution of networks of utilities, excavations, etc.

4. New techniques of demolition that allows recycling and reuse of materials (considering internal re-use or towards other applications), even more than one time.

5. Development of concepts for building "inspectable" structures

<table>
<thead>
<tr>
<th>route/ network</th>
<th>En route works required</th>
<th>(Component) Struct. system</th>
<th>sub-component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New modular construction and maintenance techniques for a traffic adaptive use</td>
<td>New techniques for repair, maintenance and upgrading of components</td>
<td>New and enhanced materials with new performances</td>
</tr>
<tr>
<td></td>
<td>New modular construction and maintenance techniques for a utilities and services adaptive use</td>
<td>Industrialization of structural components.</td>
<td>Construction, maintenance, replacement</td>
</tr>
<tr>
<td></td>
<td>New techniques of construction and upgrading with minimum environmental impact, reduced construction time and minimum impact on traffic and demand</td>
<td>New techniques for dismantling and re-use of components</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development of novel structural systems based on the optimum combination of conventional and new materials</td>
<td></td>
</tr>
</tbody>
</table>

2030
Exploitation of new technologies

2020
Development of materials and techniques
Reduction of impacts

Cost optimisation
New techniques
New/enhanced materials

2010
6. New techniques for dismantling, decommissioning and re-employment of components (incl. foundation elements)
7. New techniques to improve the performance of existing embankments and foundations using in-situ microbial processes.
8. New techniques that will enable integration of new utility networks (gas, water, sewer, electricity, etc.) in a single built infrastructure or duct.
9. Development of the techniques and technology to enable the physical adaptation of pipeline infrastructure by using, for example, smart materials/devices or interactive infrastructures with (evolving) self-knowledge

**7.3.4 ENHANCED MANAGEMENT**

1. Full asset management systems considering all important infrastructure components, related activities and constraints (data management, inspection, planning and realisation procedures, cost-benefit analysis procedures).
2. New ideas for network-wide management and operations, with an emphasis on customers in the provision of services.
3. Development of models and tools for risk and safety management integrating issues such as safety culture, business processes, roles and responsibilities, training and competency, quality and performance management.

Development, feasibility and application of new methodologies for the optimal and comprehensive management of operation, maintenance and upgrading, with a low impact on service, of:

- transportation infrastructures in the urban and extra-urban context
- high pressure transmission pipelines.
- gas distribution networks.
- of water distribution and sewerage networks.

4. Integrated sensor technologies and communication and information technologies for real time control of network operation.
5. Management procedures also suitable for smaller regional and local networks.
6. Transfer of technology and know how to engineers and contractors so that they are well qualified for construction, installation and maintenance of networks in rural, urban and congested areas.

<table>
<thead>
<tr>
<th>CIS</th>
<th>—Full asset management systems considering all components —Integrated systems —Knowledge-based systems for life-cycle management and maintenance planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>route/</td>
<td>—Development of a series of assessment standards on European level for structures complementary to the existing standards for the design and construction of new structures —Tools for management (Decision Support Systems and information systems for SHM) —New network models taking into account the management needs —Knowledge-based systems for life-cycle management and maintenance planning</td>
</tr>
<tr>
<td>network</td>
<td>—Procedures and standards —Global management of individual components —Expert systems</td>
</tr>
<tr>
<td>(Component)</td>
<td>—New sensors and ICT —New models —Cost-efficiency/maintenance planning</td>
</tr>
<tr>
<td>Struct. system</td>
<td></td>
</tr>
<tr>
<td>sub-component</td>
<td></td>
</tr>
</tbody>
</table>
8 INFRASTRUCTURE AT THE SERVICE OF THE CITIZENS

Answering to the increasing public demand is a must in terms of safety of supply and mobility and of security from natural and manmade hazards. Reduction of the impact on users and communities due to transport and service daily activities has to be met and the territorial development must be supported and protected and its value increased by a better development of design and construction with use of environmentally-friendly materials and technologies.

8.1 INTRODUCTION

Infrastructure use must be expanded and optimised. Disruption of service may result in large socioeconomic consequences for the European citizens. As a consequence all the aspects linked to the management and operation of networks of infrastructure are gathering more and more attention face to an increasing demand.

Safety of users and supply must be assured (i.e. road accidents, gas supply) and time lost in congestions and for worksites should be reduced.

Security of mobility and supply must be guaranteed under critical condition (i.e. climate conditions), but especially toward man-made hazards.

Interruption of service must be voided also after seismic and other natural hazards as the functionality of the networks is paramount for rescue and emergency operations.

ICT and ITS must be implemented for a better safety, efficiency, information, travel comfort and environment to a more and more demanding client/user.

Impact on the environment must be drastically reduced and this is true not only in terms of the use if natural resources and of the use of alternative forms of energy, but also in terms of the impact that operation may have on users and resident population both in rural, urban and suburban areas, such as pollution, vibration, noise, radiation, number work disruptions, fuel efficiency, etc.

8.2 TARGETS FOR 2030 AND KEY PERFORMANCE INDICATORS

Integrated solutions to improve communication between users, infrastructure and operators, improving mobility and purveying

Reduced impact of new techniques and technologies on the structural components of the infrastructure whose design and production will change, when implemented in practice in a logic of plug and play.

Security and protection of networked systems -(transportation facilities, utilities):security of use-vulnerabilities-interdependencies;

Efficiency in case of natural hazards and enhanced crisis management (evacuation)

Risk and emergencies are managed;

European networks of transport and supply are safe and secure;

Risk mitigation

Identification of critical road transportation infrastructures, such as main road corridors, freight terminals, and critical elements like bridges and tunnels

An integrated pipeline protection system incorporating e.g. remote monitoring, inspection, telemetry and communication to achieve optimum levels of security, safety of networked systems, and ensuring security of supply into the EU.
Innovative techniques and technologies to ensure maximised recycling (>50%) and re-use of materials to ensure significant reductions in the consumption of natural resources.
Radically innovative approaches to gas and water network installation, maintenance and repair which minimise environmental impacts on communities. Very high percentage of 'no-dig' interventions.
Preservation of resource environment
New systems for design, planning and upgrading able to minimise the impact on the environment and on circulation.
Insertion of new networks in the environment minimising consumption of natural non-reproducible resources.
New integrated conception of systems to take into account the development in use and habits of users and citizens

**Performance indicators**
*Minimising effects of seismic risk and natural hazards on the transport infrastructures and implementing efficient multifunctional monitoring systems*
*Reduced negative effects (noise, pollution, radiation, vibration, etc) on users and communities due to transport and service daily activities by new materials and technical solutions*
*Reduction of incidents*
*Improved fluidity of traffic*
*Information to drivers*
8.3 RESEARCH AREAS

8.3.1 SAFE ANSWER TO DEMAND AND SAFETY OF USE

1. Study, implementation and application of ICT and ITS systems to optimise the traffic, serviceability and security of networks, integrating fleet and freight management, traffic monitoring, tolling, information to users, incident and crisis management, transport of hazardous goods, service in adverse climate conditions.

- Fleet and freight management: improving mobility by tracking vehicles thus optimising delivery and respecting tight deadlines for a more competitive European economic market.
- Traffic management and monitoring: implementation and impact of tools for the optimal management and control of traffic for a more efficient traffic flow, also in presence of works sites and special events.
- Tolling operation: optimisation of the impact of tolling operations on design, realisation and operation of the infrastructure.
- Communication infrastructures (wired and wireless): sensor technologies, communications and information technologies for real time monitoring and management of networks.
- Information to users: delivering interactively of real-time traffic and weather information to users to reduce risks and speed travel time. Information dissemination, pre-trip and on trip.
- Transport of hazardous goods: reduction of risks in transport of hazardous materials in densely populated or environmentally sensitive areas or transport of exceptional loads.
- Service in adverse climate conditions: systems and technologies to help users in case of adverse climatic conditions, such as heavy rain, wind, freezing, etc.

2. Smart and Safe Utility concept: new concepts and models based on integrated sensors and information technologies for real time control of network operation.

3. Incident management and emergency calls:

- early identification of incidents so alternative routes and supplies can be identified to ensure continuity of service.
- suitable management and operative processes to deal with emergencies to speed up remediation operations and restore mobility and supply.
- quicker clearance times for incidents.

4. Management of access: identify means to ensure that security of the system is assured whilst affording easy access to the system for authorized users.

<table>
<thead>
<tr>
<th>Sub-component</th>
<th>Novel ICT technologies</th>
</tr>
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<tbody>
<tr>
<td>Route/Network</td>
<td>ICT systems to increase safety of networked systems</td>
</tr>
<tr>
<td>En route works required</td>
<td>Reduction of impact of new technologies (cost, users, physical structure)</td>
</tr>
<tr>
<td>CIS</td>
<td>Integration and inter-action with other realities to guarantee safety and demand</td>
</tr>
<tr>
<td>Struct. system</td>
<td>ICT systems for integrated management</td>
</tr>
<tr>
<td></td>
<td>To prepare installations of new technologies</td>
</tr>
<tr>
<td></td>
<td>ICT systems to increase safety of components (bridges, tunnels).</td>
</tr>
<tr>
<td></td>
<td>Impact on installation of new technologies.</td>
</tr>
<tr>
<td></td>
<td>Development of new ICT systems for integrated management</td>
</tr>
</tbody>
</table>

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Exploitation
Validation, feedback and optimization
Full Integration
Development of new ICT systems
Reduction of impacts
Feasibility of solutions

2030
2020
2010
8.3.2 SECURITY AGAINST NATURAL AND MANMADE HAZARDS AND RISKS

1. Develop models and tools for risk and safety management, integrating issues such as safety culture, roles and responsibilities, training and competency, quality and performance management, etc. which ultimately have a major impact on the safety of operations.

2. Develop models, materials, monitoring systems, components, design & constr. techniques able to:
   - have a better understanding of material and network degradation mechanisms
   - predict, measure and prove pipeline integrity
   - develop new inspection techniques (especially for non-piggable lines)
   - detect and reduce the vulnerability of pipeline networks to natural hazards (e.g. landslides) to guarantee the safety of the network

3. Develop techniques & technology to enable the physical adaptation of pipeline infrastructure by using i.e. smart materials/devices or interactive infrastructures with (evolving) self-knowledge

4. Develop new design models & techniques for gas networks less vulnerable to incidents, failures etc.

5. Design to reduce risks, with developments of tools for risk modelling and risk perception

6. Tools for risk and safety management, risk perception and risk modelling (including safety culture, training and competency, quality and performance management, etc) which ultimately have a major impact on the safety of operations

7. Development of risk assessment systems, models, materials, monitoring systems, components, design, construction and retrofitting techniques able to:
   - Reduce the vulnerability of networks form natural hazards and/or at mitigating consequences
   - Reduce the vulnerability of networks against man-made hazards (i.e. tunnels and bridges, pipelines) and/or at mitigating consequences

8. Models and criteria to define optimal strategies for the reduction of the global seismic risk, extreme weather conditions due to climatological changes, floods, fire and landslides

9. Monitoring and assessment methods to evaluate consequences and prove accessibility and availability of infrastructure of transport and supply after damage

10. Incident reaction: capacity to react promptly and effectively in order to mitigate the effects of an attack on people and infrastructures

11. Risk prioritization

12. Risk Assessment definition of a common EU regulatory framework on security and institutional continuity
8.3.3 SAFETY TOWARDS CITIZENS (ENERGY AND THE ENVIRONMENT)

1. New techniques and technologies for construction and maintenance and design concepts
   - to abate pollution of the environment due to the traffic road
   - to reduce noise and vibration transmission to the environment
   - to reduce gas venting to the atmosphere
   - to avoid pollution of the environment in case of accidents involving dangerous and hazardous goods.
   - to intervene in the presence of events environmentally dangerous
   - to reduce the use of natural resources and minimise pollution of the environment (i.e. by decontaminating soil or by new materials)
   - to reduce the size and duration of work sites

2. Develop techniques and technologies to enable small dimensioned trenching and even trenchless and new mechanised network installation techniques to reduce disruption and pollution as well as costs and working times

3. Design for environment (including cost/effectiveness performance analysis) to integrate innovative systems solutions

4. Eco-technical road infrastructure by using passive/partially passive/active systems solutions for traffic noise, vibration, air & water pollution control and by including new maintenance and re-cycling techniques and the integration of composite materials

5. Road pavement construction and maintenance low impact techniques including new maintenance and re-cycling techniques and the integration of composite materials

6. Energy recovery, use of alternative energy sources and efficient use systems solutions

7. Improvement in the relation between the infrastructure and the territory or the urban area: procedures to prevent future conflicts with uses of land due to noise annoyance and techniques to integrate the infrastructure into the territory

8. Use the space occupied by infrastructure for more purposes than transport only, for example remediation of contaminated soils or sludges.

<table>
<thead>
<tr>
<th>CIS</th>
<th>Integration in the territory</th>
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<tbody>
<tr>
<td>Route/network</td>
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<tr>
<td></td>
<td>Integration of structural systems for road traffic</td>
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<tr>
<td></td>
<td>Industrialisation of new construction processes and techniques</td>
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<td></td>
<td>New low emission road infrastructure solutions</td>
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<td>Development of materials and solutions to reduce impact due to operation</td>
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<tr>
<td>Route/network</td>
<td>Recycling/re-use of components.</td>
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<tr>
<td></td>
<td>Development of periodic and permanent structural health monitoring</td>
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<td>Development of the elements to use alternative energy sources</td>
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<td></td>
<td>Development of technologies to convert energy</td>
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<tr>
<td></td>
<td>Development of materials and solutions to reduce impact due to operation</td>
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<tr>
<td></td>
<td>Soil treatment</td>
</tr>
<tr>
<td>Sub-component</td>
<td>Improved knowledge</td>
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</table>
9 NETWORKING EUROPE: MOBILITY AND SUPPLY THROUGH EFFICIENT NETWORKS

Increase the competitiveness and guarantee the economic and social development across Europe by integrating within, between and cross-border networked systems for the quick and safe exchange of mobility, goods and supply. Minimum levels of service, reliability, security, information even under critical conditions will be pushed to higher efficiency.

9.1 INTRODUCTION

The network systems of highways, railways, waterways, and of utilities (water, sewage, gas, electricity) represent a huge investment and are essential to the economic and social well-being of society. They are expected to provide reliable service for very long periods of time, covering major technology changes, spanning several generations experience dramatic evolutions of the individual and collective aspirations for quality of life.

The increasing demand for mobility and supply is driven first by demographic growth, but also by a number of factors like urbanisation or macro economic development. Climate is another major driver that determines the intensity and the overall pattern of energy, supply and transport. All these factors converge towards critical saturation of infrastructure lines and nodes.

Efficient networks at the service of society should aim at enhancing the level of service offered to European citizens in terms of demand for mobility and supply while meeting social, environmental and economical objectives, and achieving inter-operability of lines and information.

The competitiveness and the social and economical development of Europe depend heavily on the full integration - within, between and across Member States borders- of networked systems providing a quick and safe exchange of mobility, goods and supply. The impact in the urban context must be reduced. Minimum levels of service, reliability, security, information even under critical conditions must be pushed to higher efficiency level.

9.2 TARGETS FOR 2030 AND KEY PERFORMANCE INDICATORS

The trans-European network of transport and utilities as a whole with new habits of users and citizens:

- Interoperability and inter-modality to assure fast and safe mobility in a competitive Europe in urban and extra-urban environments
- Utility networks with ease of access and minimal impact on users, quality of life, roads and other adjacent apparatus

New logistic, transport and quick exchange people traffic system
New nodal infrastructural systems, junctions and urbanisation
New multimodal networks optimise the use of infrastructure and shared facilities
Improved coordination among operators, including procedures and regulations, to assure an enhanced service such as a reduced number of interruptions
European networks are interoperable and supported by integrated information and communication systems
Safety, security and protection of networked systems of transport and supply in the EU

Performance indicators

European networks offer the highest level of service;
Reduction of incidents
Improved fluidity of traffic
Information to drivers
## 9.3 RESEARCH AREAS

1. New models to simulate transportation use and cost/benefit analysis
2. New models to simulate multimodal use against monomodal use
3. New concepts for upgrading the linkage between networks and network users
4. New concepts for demand-oriented expansion of the European networks of transport and utilities
5. New multiple choice/ multiple speed infrastructural system near road.
6. Point of inter-operability and inter-modality: new ways to exchange goods and passengers among nodes, among modes and urban and extra-urban environment
7. New concepts of multimodal infrastructure design for shared structures.
8. Study on the technical-economical reliability and feasibility of these new multimodal structures
10. New technical requirements of infrastructure node to reduce died-time.
11. Setting of multimodal centres allocated through the European Network system, and the coordination of these centres among them
12. Coordination of the different means of transport converging in a multimodal centre, including their timetables, allowing user to easily plan a trip, avoiding dead-times
13. The Trans European network of transport and utilities as a whole with new habits of users and citizens.
14. New information system between modes of transport and new coordination requirements for exchanging information among infrastructure and operators
15. Exchange of information between modes of transport and other networks
16. New coordination requirements for exchanging information among infrastructure and operators
17. Systems for the management of risk and emergencies and partial functionality of the networked system.

| CIS       | — New integrated application of multimodal infrastructure design for shared structures |
|           | — New logistic, transport and quick exchange of people traffic system |
|           | — Interoperability and integrated system for information and communication to increase security of networked systems |
|           | — Exchange of information |
|           | — Quick exchange |

| Route/Network | — New nodal infrastructural system, junction and urbanization, |
|              | — Networked systems of infrastructure against terrorism and natural hazard |
|              | — Exchange of goods and passengers |
|              | — Exchange of information |
|              | — Coordination requirements |
|              | — Management of risk and emergencies |
Organization
10 ORGANIZATION

The Focus Area is organised according to the following scheme:

**FIGURE 2 : MEMBERSHIP**

10.1.1 LEADERSHIP

The leaders of the Focus Area are Autostrade per l'Italia and Ferhl.

Two leaders will be/are appointed to coordinate the work under the corresponding sub-area. They will be in charge of the writing of the relevant documents. They will also propose the organisations to be involved in his sub-area, in concert with the leaders of the Focus Area.

10.1.2 CORE GROUP

It is formed at least by the leaders of the different sub-areas. As the focus is on the needs of owners and operators, the core group should be composed of individual operators and owners and related associations. The possibility will be examined to enlarge the core group to include organisations with a different profile. Its main tasks are management, coordination and harmonisation of the work carried out by the working group.

10.1.3 ROLE OF ASSOCIATIONS

The platform has to be industry led. For this reason it is necessary that individual organizations participate actively in it. However, it is expected that the this Focus Area will benefit largely by including the associations of category as they will guarantee the European dimension of the area both for input, feedback and harmonisation, dissemination and eventual application of the technological achievements.
10.1.4 WORKING GROUP

This is made of those organizations who are willing to contribute actively to the development of the vision and of the strategic agenda for the sector.

It is intended to cover all the following categories in this area:

- Operators
- Contractors
- SMEs
- ICT suppliers
- Material suppliers
- Research institutions
- Universities
- Equipment manufacturers
- Financial Institutions
- Associations

10.1.5 GENERAL MEMBERSHIP

It is expected to reach a wide audience, to receive input, to monitor and receive feedback during the life of the platform on the work carried out, and to disseminate results. Its composition will reflect follow the same criteria as for the Working Group.

10.1.6 POLICY TOWARD RUNNING PROJECTS AND PLATFORMS

It is expected to establish links with consortia working in projects related at different levels with the world of the “Networks”. It is hoped to have some of their members active in the Working Group and to include the others in the General Membership.

For this specific Focus Area it is also necessary to work in close collaboration with the already running Platforms (ERTRAC, ERRAC, ACMARE, ACARE, ESWRAC, Industrial Safety, WSSTP). Strict cooperation has already been established with ERTRAC (Ferhl), ERRAC (Banverket) and WSSTP (UKWIR).
10.1.7 IMPLEMENTATION PLAN

- Development of Vision 2030 (done)
- Development of SRA (done)
- Development of Road map (pending)
- Implementation of research (pending)

According to the following diagram

![Diagram showing the implementation plan]

**FIGURE 4 : IMPLEMENTATION**

The FA will work according to the following scheme

![Diagram showing research areas]

**FIGURE 5 : ACTIVITIES**
10.1.8 CALENDAR
The main deadlines for the Platform and Focus area are shown below:

<table>
<thead>
<tr>
<th>Month</th>
<th>General</th>
<th>Networks</th>
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<tbody>
<tr>
<td>Oct. 25, 2005</td>
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<td>January, 2006</td>
<td>Core Group</td>
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<td>FA General Assembly</td>
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<tr>
<td>July, 2006</td>
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<td></td>
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</tbody>
</table>

10.1.9 COSTS AND FUNDING
Initially each participant will cover its own costs.

Successively, it is expected to receive support from National and European Research funds and/or private funding. It is therefore planned to promote a number of research proposals with the cooperation of the participants to the Focus Area.
10.2 MEMBERS

Any European interested organization is invited to participate actively in this Focus Area

10.2.1 MEMBERSHIP AND PARTICIPATION

Participation is:

- Upon invitation of the Focus Area leader.
- In writing by any organisation who wishes to join

Together with organisations already involved in running or completed European projects, connection will be established with participants who can complete the skills and which can bring the necessary integration for reaching the expected outputs.

Both Invitations and Requests of Participation will be based and evaluated with the exclusive criteria of integration and efficiency of the group.

The members are grouped in the following classes:

- Operators
- Contractors
- SMEs
- ICT suppliers
- Material suppliers
- Research institutions
- Universities
- Equipment manufacturers
- Financial Institutions
- Associations

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<th>Company’s name</th>
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<td>UIC</td>
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<tr>
<td>Transport for London</td>
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<td>UKWIR</td>
<td>UK</td>
<td>Water distribution and sewerage</td>
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### Owners and Operators

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### Consulting/Engineering Companies

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ICT, Materials. Monitoring suppliers and Equipment manufacturers

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