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The backbone of transport system

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Road Infrastructure

The backbone of transport system

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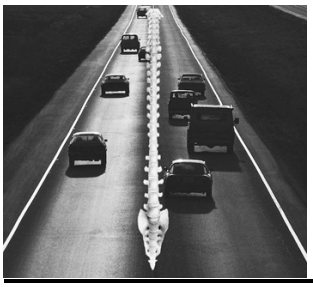
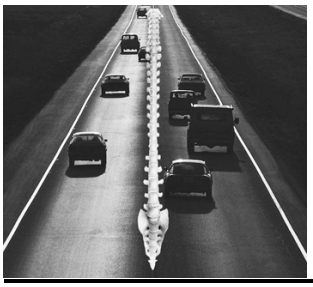
INTRODUCTION



Why infrastructure?

Transport infrastructure is a key element for the economic growth and development and it plays a fundamental role to achieve the Lisbon objectives to increase growth and jobs in Europe.
Efficient infrastructure warranting accessibility attracts centres of production and consumption and thus impacts positively on the regional economy.
More efficient infrastructures enable a better mobility for people and goods as well as a better connection between regions.
Transport infrastructure influences both the economic growth and the social cohesion. A region cannot be competitive without an efficient transport network.
The latest EU enlargement, involving less competitive economies, increased the need for attention on the transport issues. The new EU Member States have an urgent need to modernize their infrastructures and to enhance connections both inside their territories and with other countries, in order to gain access to international markets, and to equalise differences with the rest of the Union.
An increased mobility demand is also influenced by our ageing society and by the flexible work patterns more and more applied in various sectors. This is bringing more people to the move and is increasing the request for user-friendly mobility systems.

Planning, design and construction of infrastructures have remained largely unchanged over the last century, therefore attention has to be put also on the research of new construction materials and processes with the aim to innovate the sector.
The target is to develop techniques and materials responding to the need of reducing environmental impact and increasing sustainability whilst reducing the timescales for the entire process of construction and maintenance in order to increase the competitiveness of the sector and the efficiency of transport flow.
Innovation in this field is more and more important and essential.
Research has to be concentrated on procedures and materials that minimize greenhouse gas emissions, on design and planning that – by making better use of the existing network - respect landscape and geographical diversity whilst contributing to decongestion major transport corridors, and on techniques that will ensure longer service life and reduced maintenance interventions.



Why road infrastructure?

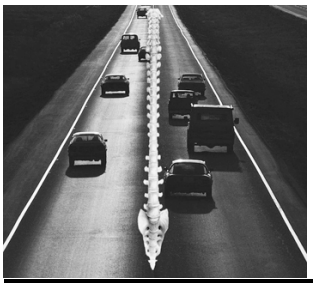
The demand for mobility of persons is increasing, based on sound societal changes.
The number of female drivers, who have historically been underrepresented in the driving population, is increasing. National and international travels will become increasingly common both for work (career paths and opportunity for employment will take people further from their home towns) and for pleasure (increasing incomes generate demand for more leisure and holiday travel). Apart from these, considering the extended duration of human life, the opportunity for travel is growing also among the elderly.
The demand for mobility of goods is also increasing; Europe's competitiveness depends on accommodating the predicted 69% growth in the amount of transported goods.

In spite of multimodality efforts, road transport has a growing trend.
Road transport is characterised by the capillarity of its infrastructure system, able to conjugate urban and extra-urban mobility in a continuous flow based on individual planning.
There is an urgency to increase road capacity and efficiency: roads must be able to absorb the ongoing and increasing flow of vehicles and ensure at the same time an adequate level of safety. Such performances must be built up in largest part on existing networks. Therefore not only new construction methods, but also sustainable maintenance of the existing network is paramount.

Maintenance deserves a special attention for two main reasons:
- road infrastructure poor condition is one of the major causes of accidents (e.g. rollovers of HV or skidding of vehicles in general);
- maintenance works impede and interrupt the delivery's free flow thus increasing their costs.

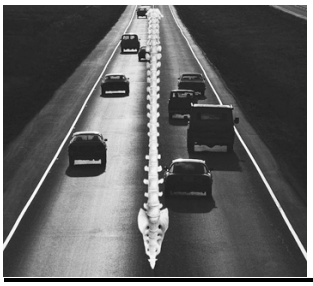
More effective and durable road maintenance techniques are needed, with a particular emphasis on improved system for safe and efficient night-time maintenance operations.
But the increased road transport demand involves also problems of environmental sustainability and security, because of the a big impact road transport has on climate change, transport being the second source of greenhouse gas emissions in Europe and road transport accounting for 92% of total transport related CO2 emissions. A more fluent traffic flow is proven to reduce vehicles emissions.
At the same time also the innovation of the construction industrial sector could contribute to more sustainable processes and techniques.

Construction materials are not yet fully recyclable and the efforts to use recycled and waste materials are countervailed by their poor durability and by the increased environmental risk.
In a continent where green spaces are more and more reduced there is the need to plan and design less invasive infrastructures so as to preserve both the environment and the landscape.



The European challenge

The recent EU enlargement, if on one hand constitutes an unprecedented impulse to the European Union, presents also a big challenge because of the different economic maturity levels of the European regions.
As far as transport is concerned, the new Member States still have scarce, not well connected, old and poorly maintained infrastructures. The new Member States need to quickly reach the Western European standards of infrastructure expansion, road safety and environmental protection, in order to achieve the EU goal of cohesion and the Lisbon objectives.
According to ERF estimates, the average motorway density in Central Europe Countries is 6.3 times lower than in the western EU countries and 14000km of new motorways need to be built within the next 10 years, simply to offer similar levels of network accessibility to Central and Eastern European citizens ("Vision: road transport in Europe 2025" FEHRL).
It is important to concentrate human and financial resources to contribute to this effort of modernisation in order to support the local regional growth.
The Lisbon Council acknowledged the importance of the European Research Area to achieve the set objectives. ERA is aimed at joining forces (national – European; public – private) in order to create the best opportunities to boost breakthrough research and improve innovation fertile environment. Its main instrument is the EC Research and Development Framework Programme. But FP alone cannot gather the needed resources to solve the problem. A stronger synergy with Structural and Cohesion Funds, as well as with the Competitiveness and Innovation Framework Programme can boost a rapid development in this sector, thus ensuring a full implementation of the Trans-European Network, backbone of a knowledge-based competitive Europe.



The EU RTD Framework Programmes

In the following chapters FP5 and FP6 strategies and objectives are recalled and funded projects related to road infrastructure are listed and analysed with the aim of presenting the evolution of the importance of the infrastructure themes throughout the following programmes.

The renewed approach of FP7 Sustainable Surface Transport sub-theme will conclude this analysis.

FIFTH FRAMEWORK PROGRAMME

Fifth Framework Programme (1998-2002)

The main research objectives of the Fifth Framework Programme and the specific programmes for implementing them are defined on the basis of a common set of criteria divided in three category actions that will apply simultaneously.

Criteria related to the **Community added value** and the subsidiarity principle - so as to select only objectives which are more efficiently pursued at the Community level by means of research activities conducted at that level.	♦ need to establish a "critical mass" in human and financial terms, in particular through the combination of the complementary expertise and resources available in the various Member States; ♦ significant contribution to the implementation of one or more Community policies; ♦ addressing of problems arising at Community level, or questions relating to aspects of standardization, or questions connected with the development of the European area.
Criteria related to **social objectives** - in order to further major social objectives of the Community reflecting the expectations and concerns of its citizens.	♦ improving the employment situation; ♦ promoting the quality of life and health; ♦ preserving the environment.
Criteria related to **economic development and scientific and technological prospects** - in order to contribute to the harmonious and sustainable development of the Community as a whole.	♦ areas which are expanding and create good growth prospects; ♦ areas in which Community businesses can and must become more competitive; ♦ areas in which prospects of significant scientific and technological progress are opening up, offering possibilities for dissemination and exploitation of results in the medium or long term

Figure 1 (http://cordis.europa.eu/fp5/src/criteria.htm)

The European Community Fifth RTD Framework Programme consists of two different typologies of programmes:

- four Thematic Programmes focused on a series of well-defined problems (First Activity);
- three Horizontal Programmes focused on needs common to all research areas (Second, Third and Fourth Activity).

THEMATIC PROGRAMMES

Activity	Programmes
First Activity Research, technological development and demonstration programmes	♦ Quality of life and management of living resources ♦ User-friendly information society ♦ Competitive and sustainable growth ♦ Energy, environment and sustainable development

HORIZONTAL PROGRAMMES

Activity	Programmes
Second Activity Promotion of cooperation in the field of Community RTD with third countries and international organizations	♦ Confirming the international role of Community research
Third Activity Dissemination and optimization of the results of activities in Community RTD	♦ Promotion of innovation and encouragement of participation of small and medium-sized enterprises (SMEs)
Fourth Activity Stimulation of the training and mobility of researchers in the Community	♦ Improving human research potential and the socio-economic knowledge base

Figure 2 (http://cordis.europa.eu/fp5/src/struct.htm)

It is useful for the aim of this research to concentrate the analysis on the following thematic programmes:

-User-friendly information society (IST);
-Competitive and sustainable growth (GROWTH);
-Energy, environment and sustainable development (EESD);

1) User-friendly information society (IST)

The "Information Society Technologies" (IST) and its progress are considered in FP5 a big opportunity and a big challenge for citizens, industry and governments.

It is supposed they can give an outstanding contribute to reach the objectives that the European Commission has set at the Lisbon European council in March 2000: "To become the most competitive and dynamic knowledge-based society in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion"

Despite the importance of IST and despite its diffusion and the growing use of Internet, the products are still hard to use, so we are far from taking full advantage of the potential of IST.

For this reason the focus was on the future generation of technologies looking for computer and network integrated into the everyday environments and user friendly human interfaces.

The programme was structured in four key actions:

- System and services for the citizen
- New methods of work and e-commerce
- Multimedia contents and tools
- Essential technologies and infrastructures

Key action 1: system and services for citizen.

This key action was focused on the research of technologies and interoperable user-friendly systems for everybody, from anywhere at anytime. It proposes five thematics with several action lines. We concentrate our analysis on the last thematic, precisely on the action line "Intelligent transport infrastructures".

Intelligent transport infrastructures

"Objectives: To improve mobility management in support of sustainable economic growth in Europe and for improving the quality of life of citizens.

Focus:
· Advanced IST surveillance and control systems focused on safety in road tunnels and railways.
· Intelligent integrated urban and interurban traffic management systems, including coordinated motorway control, management of large-scale events and crises, management of over-saturated networks and network disruptions, including advanced modelling and simulation.
· Advanced IST systems for supporting logistics and co-operative resources management for the whole transport chain."

2) Competitive and sustainable growth (GROWTH)

The main objectives of the Growth programme were:

- to support economic growth and create new jobs;
- to develop new high quality and environment- and consumer-friendly products and processes;
- to support the on-going innovation of manufacturing, processing and services enterprises (including SMEs) so as to improve their competitiveness;
- to implement Community policies that make possible competitive and sustainable development.

The programme was structured in three main interconnecting components:

- Key Actions helping to solve well defined problems developing critical technologies, concepts and policies;

- Research and technological development activities of a generic nature (multi-sectoral application)

-Support to research infrastructures

The four key actions were:

1) Innovative products, processes and organisation;
2) Sustainable mobility and intermodality;
3) Land transport and marine transport technologies;
4) New perspectives in aeronautics.

The projects object of this analysis are involved in the Key actions 1,2 and 3.

Key action 1: Innovative products, processes and organisation

Research has to help competitive industries to play an important role in contributing to sustainable development using innovative, safer, cleaner and low natural resources processes and product-services.

For this reason, this Key action would like to contribute to three medium-long term goals:

- contributing to modernisation of industry and adaptation to the new economy;
- reducing inefficiencies and overall life-cycle product cost improving quality within the value chain
- minimizing waste and resource consumption.

This key action defined five target research actions (TRAs) of which only the fifth one is relevant for this analysis.

Infrastructure

Safe, sustainable and cost-effective construction and civil infrastructures

"Buildings and infrastructures play a role in support of sustainable economic growth and have a very direct effect on the generation of wealth and quality of life in the EU. The aim of the research action is to encourage long-term innovation in relation to the design, construction, maintenance, operation, rehabilitation and upgrading of such industrial products.
The target is to address quality, efficiency, safety, sustainability and reliability aspects"

Key action 2: Sustainable mobility and intermodality

This key action was one of the most policy-driven. It aimed to merge the ongoing increase of demand for transports with the growing need to respect environment and to improve safety.

To attain this goals this key action tried to involve all stakeholders by encouraging the development and the use of new services and new technologies.

The key action concentrated its effort on:

- Promoting sustainability (that is looking for a balance between increasing demand of transport and the need to reduce its impact)
- Enhancing the efficiency and quality of transport system and services (improving the overall cost-effectiveness)
- Improving safety and security and optimising the human role and performance (increasing level of safety and user friendliness for user and society)

The research objectives were three:

1) Socio economic scenarios for mobility of people and goods
2) Infrastructures and interface with transport means
3) Transport management

But we concentrate our attention on the first and on the second objectives.

1) Socio economic scenarios for mobility of people and goods

Considering that the ever-increasing demand for transport is due to the economic, social, political, demographic and technological developments, the aim was to build new strategies and new tools for dealing with it.

The growth workprogramme identified three subareas: under the third one - Policies for sustainable mobility – are the projects considered in this research.

Policies for sustainable mobility

"Research on policies evaluation, implementation, acceptance and their further development will enhance the decision-making process and the execution of policies at pan-European , EU, national and regional levels. An improved **development and implementation of policies** require research on strategies for dealing with possibly conflicting policy objectives and their implementation in terms of transport demand, environmental and safety impact, social, economic and regional cohesion, land-use planning; policy evaluation that combines economic analysis, environmental impact and safety assessment; regulatory enforcement techniques and methods as well as tools to measure the impact of non-enforcement of regulations; optimal legal, institutional and organisational structures for the transport sector as well as evaluation of needs and opportunities for public intervention and public-private partnerships. Finally research will also have to address optimal pricing policies, their relationship with infrastructure investment and operational strategies, their impact on society and ways to increase their public acceptability."

2) Infrastructures and interface with transport means

The growth programme considered transport as an integrated system, for this reason the main goal of this research was to increase interconnectivity and interoperability in order to improve their integration (in terms of infrastructure, transport means, equipment….) and to strengthen the modes, which implied improving both safety and environmental-friendliness

This research objective was divided in five sub areas:

- Infrastructure development & maintenance
- Environment
- Safety
- Security
- Human factor

Infrastructure development & maintenance

"The further **development, interconnection and interoperability of transport networks, in particular the Trans-European Transport Networks (TENs)** require research to address specifications for technical and administrative interoperability within and across modes; the identification of Trans-European and network effects of TENs and strategies to maximise their beneficial impacts; methodologies and best practices for improving the integration between local, regional and Trans-European and Pan-European networks, particularly in cross-border situations including new concepts to optimise the intermodal use of cargo units.
The optimisation of **nodal areas and terminals**, key elements of seamless intermodal networks, requires planning and design tools to better integrate ports, airports and inland terminals in the network as well as good practice guidance in planning, financing and operating accessible passenger interchanges.
For an improved and cost-efficient **infrastructure maintenance,** research will provide tools for infrastructure management and maintenance such as methodologies for life cycle cost assessment and business process re-engineering, infrastructure materials and tools to optimise the interaction between the infrastructure and the vehicle and strategies for cost-effective and reliable maintenance of transport means as well as condition-based and reliability-centred systems for infrastructure management for all types of infrastructure and all safety-critical components.
In order to develop innovative and cost-effective **alternative transport concepts** and to assess their potential impact, research is required on two areas. First, the needs and
opportunities for new transport means and systems over the next 10 to 30 years, such as the innovative use of pipelines, floating tunnels, automated underground distribution systems, large capacity transport means, including investigations as to how current means could fulfil future requirements and how innovative technologies can be integrated. Second, the safe, efficient and environmentally-friendly integration of new means of transport, e.g. high-speed vessels, into existing transport operations."

Safety

"The aim is to develop and implement systematic approaches to safety in all modes of transport within a cost-effectiveness perspective. Research should provide the foundation for harmonised pan-European safety regulations.
The development of methodologies for a **systematic safety approach and risk_analysis** in transport requires first of all common methodologies and tools for hazard and risk analysis, for the establishment of safety requirement targets and related safety control procedures and for the elaboration of safety assurance and management procedures as well as systematic approaches to emergency situations, including passenger survivability and evacuation from transport means and all kinds of infrastructure and for search and rescue. Furthermore, methodologies for cost-effectiveness assessment of transport safety measures and vehicle design improvements and methods and tools for implementation and enforcement of safety regulations and strategies will need to be developed, including also for the transport of dangerous goods. Finally, rules and procedures for the integration and use of safety enhancing navigational, management and information systems and automated solutions as well as assessment of the role of the human element and how to ensure a positive impact of telematics on safety and the increased use of communication devices needs to be addressed, and should also take into account the results of the "User-friendly information society"(IST) programme.
Research will also address **specific safety issues,** such as the feasibility of transferring design methodologies and technologies to increase passenger survivability from the automobile area to aircraft, ships and railways, and vice-versa; safety risks of and solutions to the existence of different traffic signs and regulations across Europe; performance assessment of drivers' and crew behaviour and physical state in relation to illness, fatigue and the use or abuse of alcohol, various types of drugs and medicines as well as confidential reporting schemes for hazardous incidents"

Key action 3: Land transport and marine transport technologies

The aim of this key action was to sustain the increase of transport demand ensuring its sustainable development as well as maintaining and consolidating the European competitive position of the road, rail, waterborne, and intermodal supply industries.

This key action aimed also at reducing energy consumption and at enhancing safety, reliability and availability.

The two Research objectives are:

- "Development of critical technologies" (both for road and rail transport and for maritime transport)
- "Technology platforms"

Efficient, clean and intelligent road and rail transport vehicle technologies

"This research target focuses on propulsion, new low weight material and vehicle concepts, low noise and vibration suppression and improved aerodynamic performance. Key words include: ultra-low and near-zero-emission vehicle propulsion systems, power train optimisation technologies, technologies for vehicle structures and components, for vehicle noise and vibration suppression, for improved vehicle aerodynamics. "

3) Energy, environment and sustainable development (EESD)

The main goal of this programme was to contribute to sustainable development by giving attention to outstanding activities for social well-being as well as economic competitiveness.

It was composed of two sub-programmes: "Environmental and sustainable development" (relevant for this analysis) and "Energy".

Environmental and sustainable development

The aim of this sub programme was to promote science and technology that could balance attention to the environment and improvement of quality of life with growth, competitiveness and employment.

It presented four key actions:

1) Sustainable management and quality of water;
2) Global change, climate and biodiversity;
3) Sustainable marine ecosystem;
4) The city of tomorrow and cultural heritage.

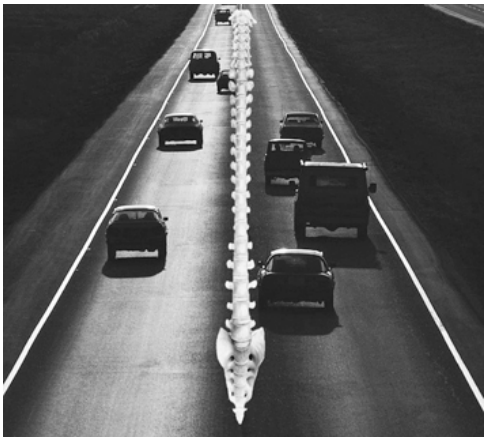
The city of tomorrow and cultural heritage

"The *City of Tomorrow and Cultural Heritage* Key Action aims to improve urban sustainability through delivering real, noticeable benefits to citizens throughout the EU by 2010. It will achieve this by concentrating these resources on four specific areas:

- city planning and management,
- cultural heritage,
- built environment,
- urban transport,

where action is urgently required and where there is untapped technological potential and strong demand for new solutions from cities themselves

- by focusing primarily on the integration and co-ordination of outputs from other EU and national research programmes, thus avoiding duplication of effort
- by selecting only projects likely to have significant impacts, regionally and at European level, managing and clustering them with a view to practical implementation and the transferability of their results
- by ensuring appropriate end-user involvement, and creating transnational networks with the capacity, opportunity and motivation to continue to exploit and disseminate results after the research phase is completed."



List of FP5 funded projects related road infrastructures

Construction

Programme: FP5-EESD

Subprogramme area: Key action City of tomorrow and Cultural Heritage, Strategic approaches and methodologies in urban planning towards sustainable urban transport

ARTISTS (Arterial streets towards sustainability)
Project cost: 2 223 904 € Project funding: 1 670 407€
Project status: Completed

Programme: FP5-GROWTH

Subprogramme area: Infrastructure development and maintenance

FORMAT (Fully Optimised Road Maintenance)
Project cost: 4 524 690€ Project funding: 2 000 272€
Project status: Completed

Subprogramme area: Safety

RISER (Roadside Infrastructure for Safer European Roads)
Project cost: 2 828 476 € Project funding: 1 955 437 €
Project status: Completed

Materials

Programme: FP5-GROWTH

Subprogramme area: Key action Innovative Products, Processes and Organisation

PARAMIX (Road pavement rehabilitation techniques using enhanced asphalt mixtures)
Project cost: 3 490 003 € Project funding: 1 820 000 €
Project status: Completed

SCORE (Superior cold recycling based on benefits of bituminous microemulsions and foamed bitumen a effect system for the rehabilitation and maintenance of road)
Project cost: 2 964 798 € Project funding: 1 482 396 €
Project status: Completed

Subprogramme area: socio-economic scenarios for mobility of people and goods

SAMARIS (Materials for pavements)
Project cost: 4 820 412 € Project funding: 2 305 274€
Project status: Completed

Vehicles-Road Interactions

Programme: FP5-IST

Subprogramme area: Intelligent infrastructure and mobility management

PRIME (Prediction of congestion and incidents in Real time, for intelligent Incident Management and Emergency traffic management)
Project cost: 2 644 492 € Project funding: 1 468 620 €
Project status: Completed

TOP TRIAL (Technologies for optimising the precision of MS-WIM of road transport to improve automatic overload control and European procedures for enforcement)
Project cost: 1 153 761 € Project funding: 798 738 €
Project status: Completed

Subprogramme area: Intelligent transport infrastructures

SAFE TUNNEL (Innovative system and frameworks for enhancing of traffic safety in road tunnels)
Project cost: 4 942 959 € Project funding: 2 223 048 €
Project status: Completed

Programme: FP5-GROWTH

Subprogramme area: key action land transport and marine technologies

TROWS (Tyre and road wear and slip assessment)
Project cost: 4 212 692 € Project funding: 2 249 996 €
Project status: Completed

SIXTH FRAMEWORK PROGRAMME

Sixth Framework Programme (2002-2006)

The two main strategic objectives of FP6 were "strengthening the scientific and technological bases of industry and encourage its international competitiveness while promoting research activities in support of other European policies"

It did not cover all areas of science and technology but only a limited number of thematic priorities that had been identified and was not structured by traditional research disciplines, but by current research objectives.

The Sixth Framework Programme was structured in three main blocks of activities:

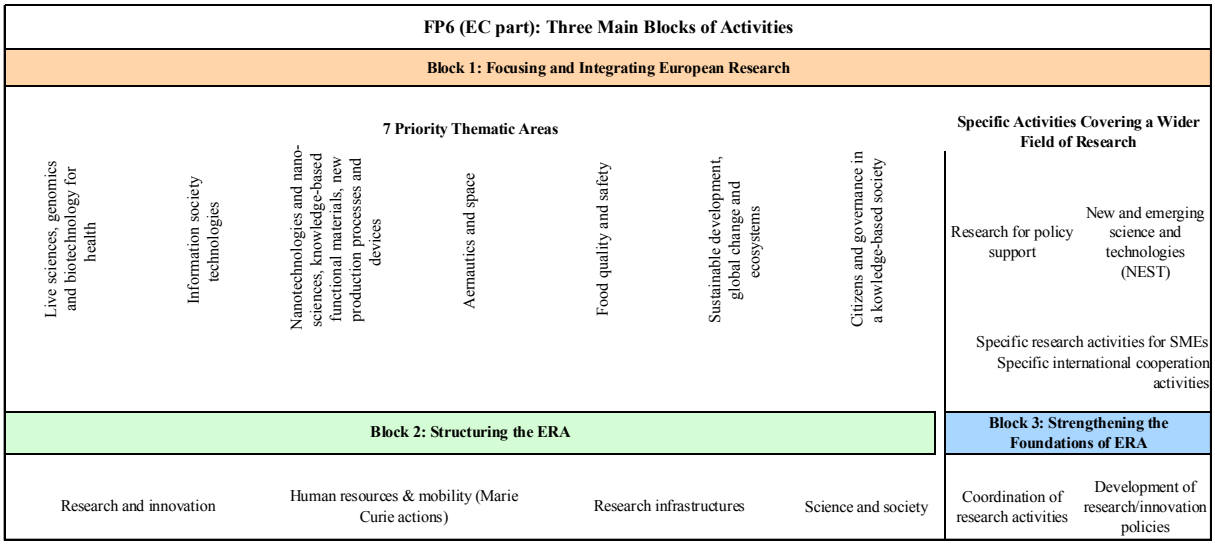


Figure 3 (http://cordis.europa.eu/fp6/stepbystep/table_overview.htm)

For the aim of this survey it is useful to concentrate the analysis on "Information society technologies" and "Sustainable development and global change and ecosystem" thematic areas.

Information Society and Media

1)Information society technologies (IST)

The objectives of IST in FP6 were to increase innovation and competitiveness in European business and industry and to contribute to the greater benefits for all the European citizens.

This thematic area focused its efforts on the future generation of technologies in which computers and networks will be integrated into the environment, making a multitude of services and applications accessible through easy-to-use human interfaces.

eSafety for Road and Air Transport

To develop, test and assess an integrated and global approach to intelligent road vehicles and aircraft which offers higher safety and value added services, where interactions between the person in control, the vehicle and the information infrastructure are addressed in an integrated way.
Focus is on:
- Research on advanced sensors and communication systems as well as highly dependable software and interfaces to integrate on-board safety systems that assist the driver in road vehicle control; advanced airborne collision avoidance systems for aircraft.
- For road transport, research in distributed intelligent agents, secure communications and advanced positioning and mapping technologies and their integration for supporting the provision of location based value added services.
- For road and air transport, work on vehicle and information infrastructure management systems with emphasis on safety and efficiency."

eSafety – Co-operative Systems for Road Transport

"Objectives:
To develop and demonstrate Co-operative systems for road transport that will make transport more efficient and effective, safer and more environmentally friendly. Cooperative Systems (as an extension to autonomous or stand-alone
systems), in which the vehicles communicate with each other and the infrastructure, have the potential to greatly increase the quality and reliability of information available about the vehicles, their location and the road environment, enabling improved and new services for the road users.
Such systems will enhance the support available to drivers and other road users and will provide for:
G reater transport efficiency by making better use of the capacity of the available infrastructure and by managing varying demands;
I ncreased safety by improving the quality and reliability of information used by advanced driver assistance systems and allowing the implementation of advanced safety applications."

2) Sustainable development and global change and ecosystem

The main objectives of this area were:

- The development, dissemination and adoption of innovative technologies and sustainable solutions in energy production and consumption, in particular through increased use of renewable energies;
- The development and introduction of environment-friendly, safe and competitive mobility system for passenger and goods transport, including all forms of surface transport, i.e. road, rail and sea.
- Improved understanding and forecasting capacities in regard to global changes, ecosystem and biodiversity as well as the creation of new management models.

This area was divided into three major fields:

1) Sustainable energy system
2) Sustainable surface transport
3) The global change and ecosystem

This analysis is focused on the second field: "**Sustainable surface transport**".

This field underlined the importance of transport in the everyday life as a decisive factor in economic competitiveness and employment. It underlined also the importance to support future economic development and subsequently traffic increase and protecting the environment. The main objective of this field was "the promotion of the surface transport sustainable development without sacrificing either economic growth or the freedom of movement"

To reach this goal it addressed the following four objectives:

- ∞ New technologies and concepts for surface transport, including novel propulsion systems, in particular fuel cells.
- ∞ Advanced design and production techniques leading to improved quality, safety, recyclability, comfort and cost-effectiveness.
- ∞ Rebalancing, integration and interoperability of different modes of transport, in particular at urban and regional level.
- ∞ Increased safety and reduced traffic congestion, in particular in urban areas, by means of electronic and telematic solutions and advanced satellite navigation systems.

The most relevant objectives for this analysis are Objective 2 "Advanced design and production techniques" and Objective 4 "Increasing road, rail, waterborne safety and avoiding traffic congestion".

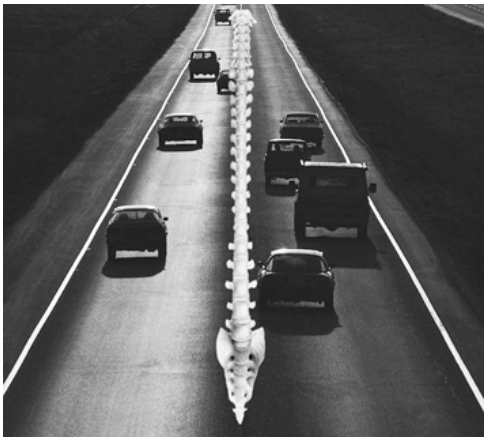
Objective 2 "Advanced design and production techniques"

"Research will concentrate on developing and promoting concepts of one-off, small series and mass customisation production environments specific to surface transport, based on the innovative use of advanced design and manufacturing.
The objective will be to achieve improved product quality and performance based on cost effective and environmentally friendly production system on a life-cycle basis."

Objective 4 "Increasing road, rail, waterborne safety and avoiding traffic congestion".

Research to support the European Transport Policy - Road Safety Strategy
"Research will combine measures and technologies for prevention, mitigation and investigation of road accidents placing special attention to risky and vulnerable users groups, including children, handicapped persons and the elderly"

Research, technological development and integration
"The Research will focus on increasing the capacity of existing and new transport infrastructure by maximising safety and well being of drivers, passengers, crew and pedestrians. The aim will be the development of strategies, system and technologies to attain optimal operational performance of vehicles and their supporting infrastructure, seeking to halve the number of transport fatalities by 2010 and increasing capacity by 15´%"



List of FP6 funded projects related road infrastructures

Constructions

Programme: FP6-SUSTDEV

Subprogramme Area: sustainable surface transport

ARCHES (Assessment and Rehabilitation of Central European Highway Structures)
Project cost: 2 941 413 € Project Funding: 1 799 930 €
Project status: Execution

IN-SAFETY (Infrastructure and Safety)
Project cost: 5 569 526 € Project Funding: 2 936 314 €
Project status: Execution

CERTAIN (Central European Research in Transport Infrastructure)
Project cost: 750000 € Project Funding: 750 000 €
Project status: Execution

HP FUTURE BRIDGE (High Performance Composite Bridges for Rapid Infrastructure renewal)
Project cost: 2 941 975€ Project Funding: 1 499 495 €
Project status: Execution

Materials

Programme: FP6-SUSTDEV

Subprogramme Area: sustainable surface transport

ECOLANES (Economical and sustainable pavements infrastructure for surface transport)
Project cost: 2 477 223 € Project funding: 1 700 000 €
Project status: Execution

SPENS (Sustainable Pavements for European New Member States)
Project cost: 2 471 150 € Project Funding: 1 299 443 €
Project status: Execution

Vehicles-Road Interactions

Programme: FP6-INST

Action line: eSafety of road and air transport

HIGHWAY (Breakthrough Intelligent maps and geographic tools for the context aware delivery of e-safety and added value services)
Project cost: 3 020 160 € Project Funding: 1 625 000 €
Project status: Completed

EASIS (Electronic Architecture and System Engineering for Integrated) ????????
Project cost: 9 610 000 € Project Funding: 4 999 985 €
Project status: Completed

Action line: eSafety Co-operative System for Road Transport

CVIS (Co-operative Vehicles-Infrastructure Systems)
Project cost:41 155 203 € Project Funding: 21 905 795 €
Project status: Execution

COOPERS (Co-operative Networks for Intelligent Road Safety)
Project cost: 16 801 755 € Project Funding: 9 799 210 €
Project status: Execution

Programme: FP6-SUSTDEV

Action line: Developing integrated safety systems taking into account Human-Machine Interface (HMI)

APROSYS (Advanced Protection System)
Project cost: 29 824 806 € Project funding: 18 000 000 €
Project status: Execution

Heavy Route (Intelligent Route Guidance for Heavy Vehicles)
Project cost: 3 161 603 € Project Funding: 1 580 801 €
Project status: Execution

Action line: Developing technologies to acquire and predict information on infrastructure conditions and parameters

INTRO (Intelligent Road)
Project cost: 3 496 456 € Project Funding: 1 999 020 €
Project status: Completed

Strategic Guidelines

Programme: FP6-SUSTDEV

Subprogramme Area: Sustainable surface transport

ERTRAC (EUROPEAN ROAD TRANSPORT RESEARCH ADVISORY COUNCIL European road transport 2020: A Vision and Strategic Research Agenda)
Project cost: 800 000 € Project Funding: 800 000 €
Project status: Completed

ERTRAC II (Technology Platform for European Road Transport Research)
Project cost: 1 550 000 € Project funding: 1 550 000 €
Project status: Execution

Action line: Developing technologies to acquire and predict information on infrastructure conditions and parameters

MISS (Monitor Integrated Safety System)
Project cost: 2 986 098 € Project funding: 1 499 977 €
Project status: Completed

Action line: Design and manufacture of new construction concepts for road, rail and inter-modal infrastructures

NR2C (New Road Construction Concept)
Project cost: 4 773 992 € Project funding: 2 000 000 €
Project status: Completed

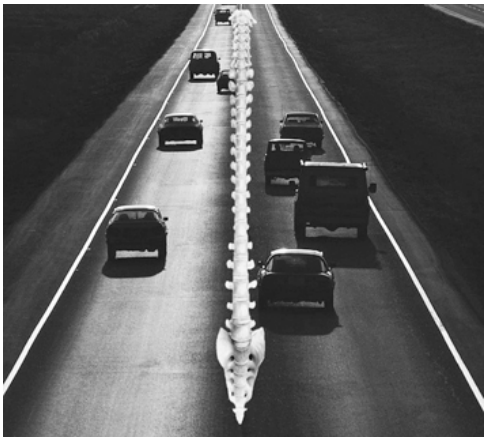
Action line: Road infrastructure safety

RANKERS (Ranking for European Road Safety)
Project cost: 3 971 355 € Project funding: 2 580 000 €
Project status: Execution

RIPECORD ISEREST (Road Infrastructure safety protection-Core-Research and Development for road safety in Europe
Project cost: 3 424 061 € Project funding: 2 599 325 €
Project status: Execution

Coordination of national activities

ERA-NET ROAD (Coordination and implementation of road research in Europe)
Project cost: 2 511 500 € Project Funding: 2 511 500 €
Project status: Execution



Case Studies

Fifth framework programme

FIFTH FRAMEWORK PROGRAMME

PARAMIX (Road Pavement Rehabilitation Techniques using enhanced asphalt mixtures)
www.cimne.com/paramix/

Pavement recycling is one of the possibility for road maintenance. It provides very important savings compared to conventional options (i.e. addition of new pavement layers). It also reduces environmental impact (lower need of aggregates and eliminates rubbish dumps), diminishes the use of hydrocarbon binders based on petrol and minimises the need of transport during the building process. The economical gains will surely revert in an increase of safety in the overall road network as more roads can be rehabilitated for the same investment.
The objective's
- Research and development of machinery and methods for a competitive laying and compaction of the mixtures with the desired quality and paying special attention to process variables such as mixture temperature, wetting and other associated processes.
- Development of a non linear three-dimensional computational (finite element based) model for predicting cracking and damage in the asphalt pavement under cyclic loading. The model will allow the enhanced design and life time assessment of the rehabilitated pavement taking into account the asphalt mixture characteristics and the rehabilitation process during milling and laying operations.
- Proposal of recommendations and rules summarizing the experience from the new pavement rehabilitation and analysis methods and the evaluation of the overall cost-efficiency of the process on prototype road sections built and tested within the project.
The new road pavement rehabilitation techniques developed in the project will aim to solve the following short-comings of existing procedures:

i. Increasing the short and medium term stiffness of the new pavement. Standard rehabilitation procedures lead to a poor cohesion of the binder and a lack of compaction of the mixture during the laying process.
ii. New computer-based for life-cycle assessment of the pavement. A computational model combining advanced finite element methods and a constitutive model based on mixing theory will be developed in order to evaluate damage in the pavement caused by limit stress conditions and the structural performance and safety under external action.

TROWS (tyre and road wear slip assessment)

http://vd.wt.tno.nl/trows/

TROWS aims to gain insight into tyre and road wear processes in order to reduce both tyre and road wear.
Reduced tyre wear leads to a decrease in:
- emission of rubber
- worn tyres disposal
- energy for tyre production
- vehicle maintenance costs

By road wear reduction road maintenance is reduced.
TRows will:
-allow tyre manufactures to improve the balance between tyre wear and other design factors;
-provides road manufacturers with improved design rules and maintenance plans for road surfaces.
The models and test procedures that are developed in this project allow a more effective design process for tyres and vehicle suspensions and will lead to improved design rules for both tyres and road surfaces.

RISER (Roadside Infrastructure for Safer Roads)

http://www.irfnet.eu/images/riser/info10.pdf

IT is a European project which addresses the problem of how to minimise the consequences of single vehicle collision.

The underlying belief of RISER is that single vehicle collisions - responsible for 14,000 deaths a year in Europe alone - will continue despite the best attempts of road safety research. However, solutions exist that can reduce the number of these accidents as well as minimise the severity of collisions that do occur;

Over the course of its 36-month existence, RISER specifically addressed the scientific and practical issues involved in analysing the performance of roadside elements in order to develop guidelines for their optimal design and maintenance. These guidelines are now available as a condensed reader-friendly brochure providing access to all major project deliverables.
Specific RISER Objectives are:
-Collect performance data for roadside environment:
  road restraint system, ditches, trees, poles
  collision data, maintenance data, influence on traffic
-Understand the connections between service and test conditions to guide road designers

-Identify the design and maintenance practice today and build up better guidelines based on the whole life cycle of the infrastructure:
  identify type of structure
  dimensions
  impact of the infrastructure: costs, safety, operations

Sixth framework programme

SIXTH FRAMEWORK PROGRAMME

CVIS (Co-operative networks for intelligent road safety)
http://cvis.odeum.com/

CVIS is an European research and development project aiming to design, develop and test the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure. Based on such real-time road and traffic information, many novel applications can be produced. The consequence will be increased road safety and efficiency, and reduced environmental impact.
The project's ambition is to begin a revolution in mobility for travellers and goods, completely re-engineering how drivers, their vehicles, the goods they carry and the transport infrastructure interact.
The CVIS objectives are:

- to create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other in a continuous and transparent way using a variety of media and with enhanced localisation;
- to enable a wide range of potential cooperative services to run on an open application framework in the vehicle and roadside equipment;
- to define and validate an open architecture and system concept for a number of cooperative system applications, and develop common core components to support cooperation models in real-life applications and services for drivers, operators, industry and other key stakeholders;
- to address issues such as user acceptance, data privacy and security, system openness and interoperability, risk and liability, public policy needs, cost/benefit and business models, and roll-out plans for implementation.

CERTAIN (Central European Research in Transport Infrastructure)
http://certain.fehrl.org/index.php

CERTAIN is a *Coordination Action* (CA) funded by the Directorate-General for Research under its *Sustainable Surface Transport priority*. Its aim is to facilitate integration of the EU New Member States (NMS) and other Central and Eastern European countries (CEEC) into the established research and development community of the European Union.
Its main objectives are:

- To provide a platform for coordinated work and efficient dissemination of results of on-going EC research projects on road infrastructure, particularly those dedicated to the New Member States: SPENS on pavements and ARCHES on highway structures.
- To establish and reinforce links with stakeholder in NMS and CEEC by organising dedicated workshops and providing the key project deliverables in their own languages.

To set the route for more efficient incorporation of partners from NMS and CEEC in the future European research by organising training courses for the research project managers.

NR2C (New Road Construction Concept)
http://nr2c.fehrl.org

New Road Construction Concepts (NR2C) is an innovation project of FEHRL supported by the European Commission under the Sixth Framework Programme. The project provides future-oriented initiatives for the road infrastructure, in dialogue and cooperation with external partners such as special interest groups, experts and users. NR2C develops long-term perspectives and physical trial projects and demonstrations, in which long-term visions and ideas are linked to short-term action.
Surface transport infrastructures in European countries represent a tremendous heritage. Their adaptation to new societal demands is a major objective. The development of new technical innovations is slow, due to the multiplicity of road owners, the lack of design guidelines and cost/benefit ratio information. Furthermore innovations have not been integrated into a global vision of the road of the future.
NR2C aims at addressing these issues by:
-expressing and deriving new concepts for the roads of the future, from a global perspective
-developing a number of targeted innovations of special interest
Some concepts will be analysed and ranked through a multi-criteria analysis that includes large-scale socio-economic considerations within the scope of sustainable development. The selected concepts will be then further developed in order to prove their technical and economic feasibility, clarify unsolved problems, propose specific innovations for problem resolution, and lay out a path towards their progressive implementation.

Seventh Framework Programme (2007-2013)

The programme has a total budget of € 50 billions and it is a key tool for helping Europe to respect Lisbon Strategy and to maintain leadership in the global knowledge economy. The activities funded by the 7th framework programme must have a clear "European added value".

In addition to the usual rule of "transnationality" which means that the consortia that carry out the research projects have to be composed by participants from different European countries and from European partners countries, in FP7 there is also a new action for "individual teams" with no obligation for transnational cooperation. In this case the "European added value" comes from the possibility to raise the competition between scientists in "frontier research" at a European level.

The 7FP has two main strategic objectives:

1) to strengthen the scientific and technological base of European industry;

2) to encourage its international competitiveness, while promoting research that supports EU policies.

It is structured in 5 main specific programmes:

a) **COOPERATION:** it is the core of FP7 and represents the two third of the overall budget. It has to be implemented by transnational consortia.
b) **IDEAS**: it supports "frontier research" on the basis of scientific excellence and there is not obligation for cross border partnerships.
c) **CAPACITY**: it focuses on research capacities that EU needs to enhance.
d) **PEOPLE**: it supports researchers' mobility and career development.
e) **EURATOM** (Nuclear research) which has two specific programmes: fusion energy research, nuclear fission and radiation protection and cover the activity of the JRC (Joint Research Centre) in the field of nuclear energy.

COOPERATION

The specific programme consists of ten thematic areas; one of these is TRANSPORT (including aeronautics). For the first time this area acquires an identity, becoming a full stand-alone programme.

Objective:

"Based on technological and operational advances and on European transport policy, develop integrated, safer, "greener" and "smarter" pan-European transport system for the benefit of all citizens and society and climate policy, respecting the environment and natural resources; and securing and further developing the competitiveness attained by the European industries in the global market."

Considering the differences inside transport sector this theme is divided into 3 sub-themes:

1) AERONAUTICS and AIR TRANSPORT,

2) SUSTAINABLE SURFACE TRANSPORT,

3) GALILEO.

But a great attention is also put on synergies between the three sub-areas, because they can help to improve competitiveness and to respond to the challenges of transport system.

In 2007 for the first time since FP inception all modes of transport have been gathered together under one single Theme. This change allows approaching Transport in its systemic entirety considering all its components in an integrated way.

It considers the "system": the different transport modes, their components (vehicle/vessel/aircraft; infrastructure and users), their reciprocal interactions and interfaces, including logistics.

It embraces "integration" between research, innovation and policy; between disciplines, technologies and skills; between a variety of funding sources and between a broader range of stakeholders.

Its "approach" is in line with the major EU challenges, industrial needs and policy objectives: the **greening** of the transport system; encouraging **co-modality**; sustainable **urban mobility**; improved **safety and security**; strengthened **competitiveness**; without underestimating societal needs and social change.

In such an **INTEGRATED SYSTEM APPROACH** the role of the transport infrastructure is central, and is the one of the most relevant for regional and local authorities.

In particular when talking about **road transport**, **infrastructure** has a twofold role in the **greening** process: from one side it can improve the system performance, thus reducing energy consumption; on the other side cleaner construction and maintenance processes, use of innovative materials and end of life strategies contribute to the mitigation of greenhouse effects.

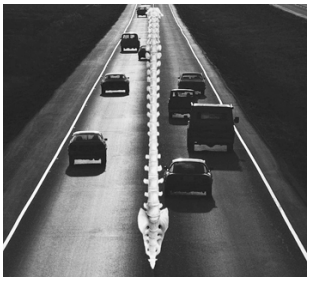
In **urban and extra-urban transport**, a reliable infrastructure is paramount to guarantee decongestion, appropriate accessibility, social security and multi-functionality.
Self-explaining, forgiving infrastructure equipped with appropriate advanced furniture and signaling can have a higher pro-active role in both primary and secondary **safety** and can contribute to reach the desired **security** level.

Only a fluid transport flow supported by a high performing infrastructure can ensure the maintenance and enhancement of industrial **competitiveness** not only at global but mostly at local level.

Following both the 2005 revised Lisbon Objectives and the concept of the European Research area (ERA), research has to contribute to Innovation, delivering results exploitable for the benefit of society.
"Intelligent transport infrastructures" are more and more being considered as an essential innovation component. Research is therefore aimed at the creation of a smart, safe and accessible road network.
Roads will become "self-explaining", easy to understand, and "forgiving" in order to minimize road users' mistakes and to reduce accidents, fatalities and injuries.
Research has to deliver intelligent roads and intelligent vehicles able to interact and communicate with the driver and to make travelling safer.
The approach of the FP7 Transport Theme is "…addressing the challenge, by considering the interactions of vehicles or vessels, networks or infrastructures and the use of transport services"

In the spirit of ERA initiatives have been launched to improve the coordination of research activities and programmes.
The scope is to encourage a balance between competition and cooperation, so that researchers are stimulated to increase the level of their results, but, at the same time, they are stimulated to cooperate with each other to address research on common issue. The coordination of research programmes and priorities contribute as well in avoiding dispel resources.
ERA also embeds the idea to obtain the most from the European diversity, enriched by the recent adhesion of new countries.
European regions and countries are progressively developing specialisation in different fields, but they are also able to gain access to the knowledge created elsewhere. One of the most effective way to encourage specialization and, at the same time, the sharing of knowledge is to encourage the mobility of the researchers.
A specific instrument aimed at the implementation of ERA is the ERA-NET.
Launched under FP6 as a separate programme, they are now directly embedded in the Cooperation Themes, thus constituting an integral part of the thematic S&T research strategy.

ERA-NET ROAD - Coordination and Implementation of Road Reseach in Europe, gathering 11 National funding authorities, is active under the Sustainable Surface Transport sub-theme. (http://www.era-road.net/).



Challenges for the future

The future challenges are to improve the capability of infrastructures to respond in the best possible way to the increase of transport demand but, at the same time, there is the need of an increased attention and a deeper effort towards both environmental issues and climate change.

It could seem a trade-off: either we respond to the demand of increasing road capacity or we put the attention to the environment's needs.

But actually the true challenge is to target the research towards the discovery of solutions that could help solving both problems.

To do this European funds alone are not enough.

Actually European research funding is 5% of the investments in research in Europe. So if we want to respond in the best way to the future challenges there is the need to pool resources and knowledge. This is possible with the collaboration between EU and Member States and with the optimized use of Community available instruments.

From 2007 on the duration of the Structural and Cohesion Funds Programme and the Research Framework programme will be the same. A stronger synergy can therefore be envisaged.

Commissioner Janez Potočnick supported this view by stating that "…the two Funds can be applied to different stages of the same project, as long as the expenditure co-financed by one of the Funds doesn't receive assistance from the other."

Such a position has been confirmed and strengthened by the recent Communication from the Commission "Competitive European Regions through Research and Innovation – A contribution to more growth and more and better jobs" (COMM2007-474) where the scheme of co-financing is completed by the Competitiveness and Innovation Framework Programme.

Transport infrastructure are at the centre of regional competitiveness, but are depending from the construction sector, which is not innovative due to the high and very long-term investments needed and the absence of a consumer market, that could push towards innovative products. Innovation funding sources are not easy to be found. On the other hand innovation in the sector is desperately needed and can only be achieved through the best use of available instruments and via a strong partnership between the European Community and the Member States who are called to share responsibility in this field.

European Commission

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Transport is widely recognised as the basic structure enabling development and growth. The road infrastructure in particular, due to its capillary dissemination, can ensure a proper level of competitiveness to Countries, Regions, and local Communities.

The Framework Programmes, following their respective basic strategies, have considered road infrastructure under different points of view and included the relevant research under different thematic priorities or programmes. The analysis presented in this publication focuses on FP5 and FP6 funded projects dealing with road infrastructure related subjects, from construction to maintenance, from performance to functionalities. The increasing role that this matter is gaining in an integrated approach to the transport system is made clear and the foreseen activities under FP7 are logically connected and presented.

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