MINISTERE
DE L'ENSEIGNEMENT SUPERIEUR
ET DE LA RECHERCHE

MINISTÈRE DE L'ÉCOLOGIE, DE L'ÉNERGIE
DU DÉVELOPPEMENT DURABLE
ET DE L'AMÉNAGEMENT DU TERRITOIRE

INRETS EU French Presidency Event
Lyon, 8-12 December 2008

"Sustainable Transport & Mobility Research and Climate Change Challenge"

SEVENTH FRAMEWORK PROGRAMME UPDATING

AND EUROPEAN ECONOMIC RECOVERY PLAN - RESEARCH PART

-Contribution of the partners of the French EU Presidency event-

This document is only committing the partners of the French EU Presidency event

February 2009

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I – Purpose and scope of this document

1. This document presents the thematic results of the meetings held by the partners of the French EU Presidency event on "Sustainable Transport & Mobility Research and Climate Change Challenge" in order to present to all surface transport research stakeholders research issues that could form an input to the Seventh Framework Programme updating but could also be useful for the research part of the European Economic Recovery Plan and other initiatives.

2. These results can be considered in fact as a first attempt, in the field of transport, to implement the Joint Programming concept developed in the ERA 2020 Vision, from the point of view of the eight European scientific networks of research providers: EARPA, ECTRI, FEHRL, FERSI, EURNEX, HUMANIST, ISN, and NEARCTIS.

3. This document includes a summary around 11 themes of the main proposals made by the eight networks, partners of the event during the dedicated plenary session. The complete presentations made by the partners in this session are available on the event website http://eufp-event.inrets.fr/ .

4. As indicated before, these ideas could form an input for several research programming activities, more specifically:
   - 5 priorities of the Cooperation FP7 programme (sub priority transport and environment of ICT priority, surface transport of transport priority, horizontal issues of transport priority, and transport related issues of environment, energy and social and human sciences priorities)
   - and/or corresponding programmes at a national level
   - research activities of the European Economic Recovery Plan
   - ERANET, ERANET+, joint programming
   - other international research bodies.

5. They could be of interest at short and/or long term for:
   - ERTRAC, ERRAC and WATERBORNE European Technology Platforms and their partners
   - Intelligent Car and Green Car Initiatives and the Construction Research Initiative
   - Industrialists' members of EUCAR, CLEPA, UNIFE (…)
   - Transport operators and infrastructure operators
   - Public authorities at European, national, regional and local levels.

6. For this reason, we release these ideas without an exhaustive editorial effort, as they could have to be adapted to different contexts, time frames and programming processes. This is also the reason why they are not necessarily following the traditional format of the yearly FP work programmes.

II - Summary of the proposals

II.A – Climate change and energy challenges

A.1 – Develop best practices and methodologies for assessment of mitigation measures

- **Technologies, Energy, Behavioural aspects, traffic & logistics organisational measures, Intermodality, ICT**
- **Integrated assessment methodologies** (accurate emissions & models, Life cycle analysis, social issues, acceptability), through extended monitoring, driver behaviours, field operational tests
- **Energy, raw materials, energy recovery in vehicles** (incl. manufacturing and recycling aspects):
  - **Energy** (and raw materials) **management** is of high concern for transport, for which significant possibilities exist. Recycling can and should be increased. Energy consumed by the recycling processes (and environmental impacts) has to be considered.
  - It is absolutely necessary to consider the quantities of raw materials that would be needed for a large scale implementation of new technologies (i.e. Lithium for batteries, Platinum for fuel cells, etc.), as it conditions their feasibility. Raw materials with low environmental impacts should be preferred for the design of transport vehicles and systems.
  - **Electric vehicles**: an integrated deployment in connection with the other consuming sectors (heating, industry) and producing sectors (especially the possibilities for storing electricity from the volatile wind power production in the batteries of cars) is needed. An overall optimisation should be searched for, implying good knowledge of traffic data, electricity needs, etc.
- **Transport infrastructure, including ITS**,and the vehicle sector have considerable potential for innovation, and thus the traditional borderlines between infrastructure and vehicles may be shifting. As regards TEN-T development over the coming decades, questions arise as to how infrastructure will need to adapt to new generations of ITS and vehicles (e.g. infrastructure implications of intelligent vehicles) and what consequences innovation in infrastructure may have on rolling stock.

A.2 – Socio economic issues

- **Transport intensity** as regards economic structure and geographical organisation should be investigated to trend to optimal configurations. **Reduction measures and policies assessment**: shared cost-efficiency assessment should be elaborated, with a good understanding of the behaviour evolution and of its elasticity, while taking into account the cross-effects. This requires **assessment methodologies and agreed hypotheses** on energy prices, rate of actualisation, etc. Agreed assumptions on costs related to vehicle, time spent, injuries, nuisances, infrastructure, are also needed.
- **Social picturing of climate change, social and political acceptability of mitigation measures**: The social representations of the climate change issues need to be followed and understood as the context is rapidly changing. Moreover, they are strongly linked with the acceptability of the mitigation measures and with behavioural changes (energy uses, mobility, driving). Assessment of reduction policies should thus consider social and political acceptability (i.e. sensitivity to GHG issues, perceived efficiency, social equity, etc.).
- **Barriers (economic, social and political) and driving forces for the dissemination of technological innovations / GHG emissions reduction should be identified**. Experiences from case studies (hybrid vehicle diffusion, etc.) should be helpful in that aim. Beyond the GHG reduction policies, appropriate instruments (regulations, economic instruments...) should be implemented.

- Information (CO^2 emission performances, on-board real-time fuel consumption) as well as public awareness campaigns are also strategic issues. **The development of models** analyzing the mechanisms of vehicle and transport mode choices should enable predicting (and influencing) the purchase of new vehicles according to exogenous variables such as exhaust emissions, greenhouse gases, costs, etc. **Such tools should aim** also at determining optimal vehicles for given missions, combination of transport modes, etc.
- **Intermodality**
  Intermodality for intermediate distances is of strategic importance for Europe. It includes in particular the development of a complementarity and share between air transport and rail and has significant implications in term of choices regarding high-speed rail network extensions and airport locations. To help in these strategic issues, methods, criteria and decision making tools should be developed. These ones imply multiple criteria optimization, and assessment methods that include door to door (travel) and dust to dust (production, use of energy) approaches.
- **Mobility and driving behaviours**
  - The **driver behaviour** (driving and vehicle usage) remains one of the key elements of the GHG emissions. Observation and monitoring is required to assess the character the real-world driving conditions as well as their evolution due to the implementation of various measures: ICT, eco-driving, training, awareness campaigns, etc. The development of on-board systems, traffic management, and communication technologies should enable large scale data collection related to vehicle use and traffic conditions. Pilot projects should be proposed to demonstrate the effectivity of such experimentation. Such experimental tools should also enable quantifying potential impact or efficiency of eco-driving campaigns.
  - **Numerous traffic related information** such as trip lengths, vehicle load, parking time, access to electrical terminal, car ownership by vehicle type and size, etc. should also be investigated for emissions inventory as well as **for the assessment of future individual transport systems**. A good description of the characteristics from the existing and future vehicles (driving resistance, weight, etc.) is also required for good forecasting of energy use and exhaust emissions by the vehicle fleets.
  - **Driver behaviour** should also be assessed as regards the development of new technologies such as electric or hybrid vehicles (definition of vehicle mission profiles needed for their optimization).
  - **Driving behaviour models** should be developed in combination with real-world measurements, to predict future driving patterns and their impacts. A systematic description of driving patterns for combinations of vehicle types and traffic situations requires the use of simulation models at different scales (from very detailed driving cycles to averaged driving conditions).

A.3 – Monitoring and pricing tools

- **A strategic issue concerns the deployment of monitoring tools** (surveys, on-board sensors, ICT and GPS deployment) for decision makers and public authorities at different geographical scales, but also for companies and consumers (tools to help the decision and the choice). Monitoring – when aimed at the user -, can be seen as a powerful instrument to influence the behaviour (actual knowledge of the real-world consumption or emission). **Agreed system of accounting the GHG should be implemented. For this purpose harmonised databases, indicators and models should be developed and shared. Harmonisation between freight and passenger transport is needed**.
  Monitoring is also needed for transport logistics, to analyse efficiency and derive best practices. Knowledge on the load factors as well as on the impact of ICT should be gained from such monitoring.

- **Integrated assessment and life cycle analysis**: Assessment of new technologies through of a single vehicle is necessary but not sufficient to relate expected real-life impacts. A number of market and traffic related data should be taken into account. Furthermore, **life cycle assessment** (LCA) (and dust to dust analysis) including environmental impacts and economical costs should be applied for both transport operations and industrial processes (including raw materials, energy, production, operation and recycling) to enable objective and exhaustive information on the environmental impacts of different technological options. Such an assessment requires enormous amounts of technical and socio-economic information.
- **Efficient pricing tools, dynamic road pricing and Electronic fee collection**.

A.4 – Data harmonization

- Data harmonization in the area of passenger transport.

A.5 – Modelling, measurement and standardisation

- **Low consumption operation and maintenance** (rail, etc.): tools are needed to help predictive driving with lowered energy consumption within certain contexts (guided systems, trains, etc.). Most data for that aim are available, but operational strategies should be developed.
- **Emission standards and regulations** should be adapted to consider components **not covered by the standard procedures** (tyres, air conditioning, auxiliaries, etc.). Energy / CO^2 labelling should also apply to these components.
- **Vehicle emissions (and fuel / energy consumption), measurement and modelling**:
  - Non-CO^2 (N2O, VOC, particulates) greenhouse gas should be measured.
  - Real-world emission measurements are needed, including the auxiliary operations and parameters not covered by the standard procedure (driving resistance, etc.)
  - **Large-scale real-world CO^2 measurements should be conducted through simple on-board measurement systems and OBD system**, for light and heavy duty vehicles, allowing a good taking into account of numerous parameters of the emissions, including driver behaviour, vehicle operation and traffic conditions.
  - **Portable on-board emissions measurements** (PEMS) have been developed, that should enable characterizing real-world emissions from road and non-road engines. Developed for regulation purpose (emission control), these systems lack appropriate methods (experimental design, etc.) to derive real-world emission factors and models.
  - **Emission models** on different scale levels constitute the base for most evaluations of scenarios in order to reduce emissions of climate gases. Emission models are currently based on average vehicles and average test conditions through test cycles. Specific models should be defined to consider malfunctioning vehicles (high emitters) as well as off-cycles conditions. These models should include all necessary input data. The use of alternative energy raises the need for energy system models to estimate energy efficiency for the transport sector. Specific developments are also needed to enable simulation of traffic management, ICT and eco-driving impacts on greenhouse gases and air pollution: indeed crucial issues related to the modelling scales, the coherence and the interfaces between demand, traffic, driver and emissions models are not sufficiently addressed by existing tools. **This requires both modelling work as well as experimental studies to develop and validate the models**.
- **Inventorying tools for non-road transports** lack of reliable emission data and traffic statistics. Significant efforts are required in particular for air traffic, which is increasing quickly. Car ownership models (addressing different vehicle categories and types) and vehicle use models (addressing mobility, mileage, etc.) should be developed as regards growth scenarios, demographic data, etc.

- **Mitigation measures assessment**
  Rigorous and coherent methodologies should be elaborated to enable an objective assessment of the different mitigation measures. Currently, we observe a large range of assessment methods for different purposes (assessment of new vehicle technologies, of traffic measures, of behavioural measures, life cycle analysis, field operational tests, etc.), which are not consistent between them to enable objective comparisons. A rationalization of the assessment methods is required. Concepts (perimeter of the analyses, parameters, etc.) should be defined as well as required metrology and methodology, to ensure coherent assessment. A preliminary typology of the mitigation measures as regards the suitable assessment methods is needed as well as the analysis of the coherence between these methods. A set of coherent and validated models (demand, traffic, emissions) should also be elaborated on these bases.
  Timescale (short term, long term) of the effects of mitigation measures should be considered with their efficiency level.
  In several countries and cities, mitigation measures have been and will be implemented. A synthesis of these experiences is needed as well as their results. Best practices should be derived from these experiences as well as recommended packages of measures. One of the main issues concerns the collection of reliable and coherent data (between countries).
- **ICT assessment and emission models**
  Due to the large range of ITS measures and of their effects, their assessment as regards traffic conditions and emissions require simulation models and field experimental tests. The current emissions and traffic models, being developed on average actual traffic conditions and driver behaviour, are not suitable to simulate the ITS or eco-driving induced changes as they do not include realistic sensitivity to these aspects. Coherent sets of models have to be developed and implemented (demand, traffic, driver behaviour, vehicle operation, emission).
- **Field operational tests (FOT) are a favourable way to assess ITS measures and enable collection** of a large range of data regarding the driving behaviour and engine operation through simple devices implemented on-board vehicles samples an satellite facilities (Galileo). Methodologies of assessment should be designed in that aim.

A.6 – Air transport issues

- **Intermodality**
  Intermodality for intermediate distances is of strategic importance for Europe. It includes in particular the development of a complementarity and share between air transport and rail and has significant implication in term of choice for high-speed rail network extension and intermodal airport location. To help in these strategic issues, methods, criteria and decision making tools should be developed. These ones imply multiple criteria optimization, and assessment methods that include door to door (travel) and dust to dust (production, use of energy) approaches.
- **Emissions**
  Works are needed for the characterization of the real-world airplane emissions. Methodologies and metrology - in complement to the standard LTO procedure - have to be developed in that aim, to characterize in-flight emissions, according to altitude and operation. Non-CO^2 greenhouse gas as well as other pollutants should be considered to enable characterization of impacts on climate change and ozone layer.
- **Inventory of GHG** and prospective: as for the other transport modes, robust prospective of the air traffic and scenarios for the air transport development are needed, taking into account new / evolving technologies and airplanes, to enable a good forecasting of the GH effects, including the international flights in the inventories. Traffic related data based on robust and real-world statistics are also needed, as well as a detailed characterization of the airport logistic and its integration in GHG inventory.

- **Mitigation measures and their assessment**
  Improved traffic management should be aimed for energy, GHG, air quality and noise optimization (multi criteria optimisation as envisaged in SESAR programmes).
  As for the other transport modes, integrated assessment approaches should be developed to enable objective comparisons of the modes, to account for the transit to and from the airports or stations for instance (by car, bus, train) in the quantification of the overall emissions from the transport mode.
- **Technology**
  Consumption on the airport (electric trailer) to from runway; research on reactor (fuel injection), technologies for high temperatures operation. Similarities / synergies should be developed with the development of road engines, electrical generator, in particular of on-board electrical-power unit).

A.7 – Breakthroughs including electrification

Green car initiative towards the electrification of vehicles

- **Hybrid electric vehicles technologies**
  Battery / ultra capacitor association: Ultra capacitors associated to batteries could improve battery life duration by insuring high transient power, mainly in recharge phases, while reduced-sized battery provides energy with an appropriate management to preserve its durability. Researches are needed to validate the feasibility and demonstrate the benefits of the battery/ultra capacitors association. Energy management with 3 sources (i.e. ICE, battery and ultra-capacity) requires research on generic management methods and multi-source systems.
  Plug-in hybrid vehicles (PHEV) have a real potential to reduce CO^2 emissions, battery sizing and cycling representing however the key point of such a solution. The researches must deal with optimisation of the energy and the battery management together with parametrical studies of the appropriate battery type and size according to the vehicle use.
- **Energy, raw materials, energy recovery in vehicles** (incl. manufacturing and recycling aspects):
  Electric vehicles: an integrated deployment in connection with the others consuming sectors (heating, industry) and producing sectors (especially the possibilities for storing electricity from the volatile wind power.
- **Future vehicles, future urban contexts**
  It should be useful to develop a future vision of the city and of the transport systems, with a significantly increased urbanization, a market of lightweight- (3-wheels, etc.) and electric- urban vehicles, new transports systems and services, adaptation to the future needs, and developments of new transport strategies (car hiring, shared cars, etc.) as well as freight transport urban logistic.
  Magnetic levitation transport systems, at low speed in urban areas are currently studied in Korea, Japan, China. A research effort should be dedicated to such system in view of their overall advantages (electric-powered, low noise, no track wear, low visual nuisances).
- "Radical changes" (new technologies, strong evolution within short time period) require new tools and knowledge and models, as a number of issues have to be raised up and anticipated without previous experiences (economy, maintenance aspects, etc.).

Intelligent car initiative (the proposals are similar to eSafety RTD WG)

- Intelligent mobility services for people
- Intelligent mobility services for goods
- Intelligent vehicle systems
- Cooperative systems
- Field Operational Tests (FOTs).

Other issues

- The integrated deployment of **electric vehicles** has to be made in connection with the other consuming sectors (heating, industry) and producing sectors (especially the possibilities for storing electricity from the volatile wind power production in the batteries of cars) is needed. An overall optimisation should be searched for, implying good knowledge of traffic data, electricity needs, and some additional issues such as:
  - Tyre/road interaction for electric cars
    - Reduction of non-exhaust particulates – concern about different patterns of tyre/road dust generation
    - Skidding resistance and rolling resistance
  - Inter-modal traffic patterns and effects on infrastructure needs
  - Safety of infrastructure (interaction of new vehicle designs with safety barriers etc
- It needs also **to improve the installation of urban utilities systems** – sub-surface detection, rapid installation technologies, and improved pedestrian accessibility.

A.8 – Adapting infrastructure to climate change

The subject is one that urgently requires greater cooperation between different stakeholders, member states and regions. The challenges facing infrastructure owners and operators, both national and local, were substantial and a pan European recognition is needed in order to reduce duplication and to be prepared before the negative impacts of the problems materialize in a substantial way.

- **Consider the unforeseen consequences of a changing climate** - differing events and issues will need to be addressed. These included those factors that might normally be anticipated such as floods, wind damage to infrastructure and tree falls, landslides and erosion, rutting of pavements as well as road closures and damage due to forest fires and the effects on skidding resistance and road safety. There is an identified need to raise awareness of these issues with relevant stakeholders and that recent events provide sufficient basis to do this.
- **Better identify the magnitude of extreme events;** the speakers identified a worrying lack of knowledge about the possible magnitudes and frequency of extreme events. Whilst there is useful information about average temperatures, rainfall and sea level rises, information is not available concerning maximum wind speeds, maximum localised rainfall levels etc. Whilst the natural reluctance of meteorologists to extrapolate outside their models is recognised, road authorities are faced with a lack of information about the events which have the strongest impacts on infrastructure design or vulnerability. Closer dialogue with meteorological experts is needed.
- **Develop a new approach using risk management -** in most cases climate change could not be addressed by simply developing existing practises. It is recognised that a risk-analysis approach is now needed where the consequences of extreme events assume greater importance. The traditional concept of 100 year event (i.e. flood, etc.) is now unsafe because the hypothesis of a stable climate is simply wrong now.
- **Identify the costs of climate change on infrastructure -** more effort should be made to determine the costs of a changing climate on Europe's road, transport networks and services. It is recognised that the political profile of infrastructure impacts is not high and consequently neither the impacts on the infrastructure nor the costs of adaptation were considered in policy discussions. Greater emphasis should be placed on identifying the costs.
- **Act promptly to reduce impacts and costs** - early implementation of existing knowledge throughout the road network could reduce the ultimate impacts and costs. Many preventative measures would not add substantially to costs or resource use although studies were needed to identify where this is appropriate.

- **Understand if compromises are needed now to avoid pain later** – It is recognised that some of the consequences of climate change may affect the ability of road authorities to meet other legislative requirements. For example, where rainfall, and consequently run-off from roads increase, meeting directives on water quality could be difficult. In addition, requirements such as those on bio-diversity or habitat fragmentation may affect the ability of road authorities to take necessary preventative actions that would mitigate the future impacts of climate changes. More research is needed in this area.
- **Recognise the interdependence of roads and the transport system** - Roads are part of an integrated transport network where impacts on one part of the system affected other modes. Specific examples included the dependence of cities on sometimes vulnerable public mass-transit systems where roads provided backup or even emergency evacuation.
- **Plan for the worst** - It is recognised that improvements are needed in preparation of emergency plans for dealing with extreme events. Such preparations should not only include the immediate emergency responses (including rescue and evacuation), the development of plans to maintain resilient networks but also to include such issues as limiting environmental damage.
- **Learn by doing** - Because of the complexity of the subject, it is recognised that the best way for appropriate expertise to be developed is by direct exposure to the problems. Therefore it is suggested that knowledge exchange is a priority when problems occur. For example, it is proposed that staff exchanges should be accelerated when dealing with disasters and extreme events. Some experts and tool are already available for operational work.
- **Share and develop technical knowledge** - It is agreed that further efforts should be considered to understand what is already known, to collate that information and share the knowledge especially in the field of floods/erosion, landslides, rock slips and avalanches, bearing capacity of roads, rutting and other pavements effects (including skidding resistance), winter maintenance and emergency planning. Systematic and organized capitalisation of experience should be organized at national level, with a European methodology to facilitate optimum use of data and avoid a replication of incidents.

II.B - Ageing population challenge (including disabled population)

B.1 - User need and user behaviour

- Study the evolution of user needs, sub-topics:
  - Urbans (demographic aspects, immigrating population, ageing population in urban population)
  - Leisure
  - Shifting from cars to alternative modes (prices, …)
- Provide a sustainable transport system matching to these new user needs.

B.2 - Ageing population and transport demand

- Population is ageing, and this will have implications on the transportation system: how will it influence transport demand, for example? Older persons is a highly heterogeneous group with heterogeneous needs, preferences and activity patterns.
- **Personalized travel systems**
  - Focusing on needs and preferences (context of use, needs, special groups etc.)
  - Model based personalized driver information and warning systems (ADAS, IVIS).

- **Safety issues**
  - Aging of population is a critical issue in many fields. As far as protection is concerned, the age effect should be introduced in evaluation tools (dummies or models). For instance, the effect of age on bone resistance to fracture is important. To be included in more general programs on age effect
  - Elderly drivers and long term effect of drivers assistance systems
  - Vulnerable traveller's compatible vehicle design, for the elderly; children and other fragile user groups, both as passengers or traffic opponents.

II.C – Mobility and transport policy, strategy and instruments support

C.1 - Best practices and Impact Assessment

- Best Practices and Impact Assessment to enhance performances and to ensure sustainable transports
- Focus on transport strategies and policies related to climate change and energy conservation with criteria as economic efficiency, fairness, equity and acceptability.

C.2 - Behavioural aspects of Mobility

- **Behavioural adaptations towards sustainable mobility**
  - Decrease in energy resources and behavioural change
  - Policy measures and assessment of these measures
  - Behavioural and cultural norms in behavioural change
  - Equity aspects: who can afford to modify mobility patterns?
  - The role of information for facilitating change in mobility and transport consumption.
- **ICT and travel behaviour**
  - Telecommuting/teleworking, e-shopping, e-medicine, e-education have been explored from consumers and company's perspective. Yet, we do not know what it means for transport demand. There are some research efforts but these are scattered, and there is no comparative research.
- **Behavioural adaptations towards sustainable mobility**
  - Some sub themes: Behavioural change & fuel prices /shortage of energy resources; Policy measures and assessment of these measures (fx. carrot vs stick); Behavioural change & behavioural and cultural norms; Equity aspects; The role of information for facilitating change in mobility and transport consumption.

C.3 - Data harmonization

- **Data harmonization on the area of person transport**
  - At the moment, data harmonization is missing; this is problem for comparative research and emission calculations, for example. A COST action starting on this in 2009.

C.4 - Optimising capacity

Road
- More efficient road maintenance techniques
- Infrastructure monitoring and maintenance management systems
- Maintenance of secondary networks

- New forms of cooperation between the private and public sectors. Methods to evaluate costs and risks
- Efficient pricing tools, dynamic road pricing and electronic fee collection
- Dedicated lanes
  - for freight and "light" infrastructure for cars
  - Systems for high-speed bus and taxi corridors
  - Effectiveness of separate lanes for road operations
  - Automated highways: systems for platooned vehicles.

Rail

- Competitiveness and technology development, innovative train concepts to improve capacity (axle load, new breaking/traction), LCC, high intelligent mobility and cost effective homologation methods to increase operational aspects.
- Infrastructure Research to match growth in traffic density at a price to be competitive and to optimise rail network maintenance and traffic management
- Improved performance of rolling stock & infrastructure (capacity and efficiency).

II.D – Urban Mobility (people and goods)

D.1 – Behaviour aspects of urban mobility

- Improve urban mobility by understanding behaviour and needs of residential and non-residential transport users with new approaches of land use and moving from research results to implementation, experimentation and real policy making.

D.2 – Non residential transport users

How far are non-residential transport users taken into account by planners? (business travellers, leisure travellers…)

- Take better account of non-residential transport users to improve all aspects of transport in the urban area (management, organisation, needs…)
- Adapt the transport services for every type of user present in the urban area (including sustainable development of transport).

D.3 - Implementation of sustainable transport measures and integrated sustainable transport plans

- Implementation of policies and measures are essential, but often overlooked. Many plans are adopted but not realized or only partly or with poor results. Implementation research is a field with much to offer in terms of understanding implementation processes and barriers and how they are sometimes overcome. But implementation theory has also to recognize new situation associated with multi-level governance, public-private partnerships, and long term concerns such as sustainability. Sustainable urban transport is a typical example of 'intractable' policy area reflecting such trends, in addition to traditional implementation issues.
- The policy objectives and the knowledge regarding relevant instruments are abundant when it comes to sustainable urban mobility. What lacks is implementation – European cities experience an implementation deficit. For that reason it is important to analyze political and institutional conditions for implementing policies, instruments and measures in favor of sustainable urban mobility, and to derive possible implementation paths.

So it is critical:

- to improve dissemination
- to speed up potential impact
- to have a more systematic approach
- to improve the cost effectiveness European research
- to better understanding of implementation processes and barriers
- to overcome fragmentation/overspecialisation in science and politics
- to define the impact of cultural differences in the implementation.

D.4 - Evaluation of the impacts of dissemination of European urban transport research

- No sufficient evaluation on the impact of dissemination of European urban transport research
- Need for management of the knowledge produced in projects
- Improved and faster transfer of research outcomes to policy making and implementation, especially concerning climate change and energy consumption.

D.5 - New approaches to land use

Urban structure is the arrangement of land use in urban areas. Its interactions with the transport system go both ways. On the one hand, the functional differences in land use and the spatial separation of functions create the need for travel and freight transport. On the other hand, the transport system determines the accessibility of places and – at the same time – has significant impact on land use. This research area is concerned with:

- the relationship between land use and transport demand
- the potential of making the development of our cities and transport systems more sustainable by coordinated planning and management of the urban structure based on sustainability objectives and policies
- interaction between land use and the reduction of car speed
- time shared land use
- inter-relation with alternative modes.

D.6 - Urban transport experimentation

It is not always possible to model or predict how road users, the general urban public, of policy makers will respond to new measures. Models may not exist or may not be able to forecast changes in behavior. Second order behaviour (policy making) may be even more difficult. Experimentation is another approach that allows transport users and policy makers to experience chances in practice before a final decision for implementation is made. Sometimes assumptions are confirmed, while in others experiments may surprise or even contribute to change agenda. The research should investigate experiments with new urban transport technologies, measures, designs, solutions, etc and examine how experiments inform and influence subsequent planning and implementation. Significant emphasis should be put on ex post evaluation of experiments, since there is limited documentation available.

D.7 - User needs and user behaviour

- Study the evolution of user needs, sub-topics:
  - Urbans (demographic aspects, immigrating population, ageing population in urban population)
  - Leisure
  - Shifting from cars to alternative modes (prices, …)
- Provide a sustainable transport system matching to these new user needs.

D.8 – ICT for Mobility of the Future

Strategic research agenda of eSafety is shared.

D.9 - ICT for Clean and Efficient Mobility

Strategic research agenda of eSafety is shared.

D.10 – Electrification of urban vehicles

- **Hybrid electric vehicles technologies**
  Battery / ultra capacitor association: Ultra capacitors associated to batteries could improve battery life duration by insuring high transient power, mainly in recharge phases, while reduced-sized battery provides energy with an appropriate management to preserve its durability. Researches are needed to validate the feasibility and demonstrate the benefits of the battery/ultra capacitors association. Energy management with 3 sources (i.e. ICE, battery and ultra-capacity) requires research on generic management methods and multi-source systems.
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  Electric vehicles: an integrated deployment in connection with the others consuming sectors (heating, industry) and producing sectors (especially the possibilities for storing electricity from the volatile wind power.
- **Future vehicles, future urban contexts**
  It should be useful to develop a future vision of the city and of the transport systems, with a significantly increased urbanization, a market of lightweight (3-wheels, etc.) and electric urban vehicles, new transports systems and services, adaptation to the future needs, and developments of new transport strategies (car hiring, shared cars, etc.) as well as freight transport urban logistic.
  Magnetic levitation transport system, at low speed in urban are currently studied in Korea, Japan, China. A research effort should be dedicated to such system for their overall advantages (electric-powered, low noise, no track wear, low visual nuisances).
- **"Radical changes"** (new technologies, strong evolution within short time period) require new tools and knowledge and models, as a number of issues have to be raised up and anticipated without experiences (economy, maintenance aspects, etc.).

II.E – Freight and logistics

E.1 - Improvements in capacity, quality & efficiency

Improvements in capacity, quality & efficiency for a higher market share in freight transport in co-modal environment.
Cross pole thematic issues at first glance:

- Capacity
  - Overall improvements in RS and Infrastructure
  - Traffic management and signaling (GPS/Galileo/ERTMS)
- Efficiency
  - Innovative maintenance concept, Time tabling, inter-modal intelligent mobility as a part of the global logistic chain
- Quality
- ETA (Expected Time of Arrival), value of improving reliability and risk prevention.

E.2 – Efficient goods transport

- Network improvement methods
- Real-time travel-time prediction methods improving reliability

- Dynamic capacity optimization models
  - Dynamic information-led traffic management and control models
  - Measuring methods for congestion
- Increased automation in traffic flow control.
  - Intelligent lane allocation
- Long term strategic analysis on the evolution of infrastructure and transport supply
- Harmonized decision indicators and standards for the level of services on the road infrastructure
- Application of ICT and ITS and Intelligent pavements, including electronic road marking, pavement surface colouring and dynamic lane barriers.

E.3 – Green corridors

Develop a comprehensive approach for freight corridors
- Taking stock of the existing so called "good practices" in the discussed subject matter.
- Taking stock of transport infrastructure and its parameters in selected European transport corridors, especially in Central and Eastern Europe.
- Application of an existing methodology (Transtools) for forecasting freight and passenger transport in transport corridors, taking into account economic factors, technological and organizational advancement which conditions material and transport intensity, economic, social factors etc.
- Verifying the methodology for forecasting transport while adapting specific, variant assumptions appropriate for conditions in selected transport corridors.
- Developing a methodology for calculating average unitary transport costs in transport corridors according to different transport branches and different types of shipments, including intermodal transport.
- Developing a methodology for the assessment of average unitary external costs of transport in transport corridors in accordance with different transport branches (taking into account intermodal transport), including inter alia.
- Unitary costs of pollutants emissions from combustion engines in real-life traffic.
- Unitary costs of noise, etc.
- Developing a methodology for monitoring average unitary shipment costs divided according to selected branches of transport and types of shipments.
- Application of cost benefit analyses for comprehensive calculation of effectiveness of infrastructure investments in transport corridors (taking into account also external costs of transport).

E.4 – Shipment CO^2 labelling

The high level objective is to establish a European standard of calculating CO^2 contents of a product based on existing and extended rules and regulations.
Other objectives are:
- A definition of the requirements of retailers and logistic service providers or forwarder by interviews or workshops should be realised.
- Based on this requirement, the development of a common methodology to calculate the CO^2 emissions for shipments in the transport processes.
- The definition of technical requirements for suitable technologies including ITC applications will give input for technical solutions that could be developed for the practical use in daily forwarding.

E.5 – Freight rail competitiveness and development

Competitiveness and technology development, innovative train concepts to improve capacity (axle load, new breaking/traction), LCC, high intelligent mobility and cost effective homologation methods to increase operational aspects.

E.6 – Long distance freight road transport

Options for a step-change in long-distance road transport, its links and interactions with other modes, relations with passenger transport and addressing key technology developments for infrastructure, vehicles and other aspects.

II.F – Other transport environmental issues

F.1 – Rail

Environment and Energy Efficiency
External vibration and noise, Electro Magnetic Compatibility, Energy consumption, Water and air pollution.

F.2 – Road

- Recycling processes
- Innovative tools for environmentally-friendly design
- Innovative monitoring and performance review.

F.3 – All transport

Health and noise or vibration network.

II.G – Infrastructure research needs

G.1 – Rail infrastructure research

- **Infrastructure Research to match growth** in traffic density at a price to be competitive and to optimise rail network maintenance and traffic management.
- **Track including sub-grade and rail**, "Switches, crossings", Level crossings, Wheel/rail interface, Signalling and control systems, Line-side equipment:
  - Track Design
  - Wheel Rail Interface
  - Condition Monitoring
  - Maintenance
  - Asset Management
  - Topic for step changes: semi-rigid track structures.

G.2 – Road Infrastructure Research

- **Preventative Road Engineering**
  - Standards, measurement & testing
  - Preparing for change
    - climate change, ageing population, etc

- Road markings, signing and signals
    - including VMS and road works
- Self-explaining roads (& tunnels)
- Infrastructure for all road users
    - including Traffic calming
- Winter maintenance
- Better surfaces

- **More efficient road maintenance techniques**
- **Infrastructure monitoring and maintenance management systems**
- **Maintenance of secondary network.**

II.H - Transport safety operation and security

H.1 - Road safety systems

General

Towards an Integrated and Sustainable Safety Research Agenda

Road Safety and the Environment

To a great extent it seems today that the proposed research agendas view Environmental Protection and Energy Efficiency in the Transportation domain as a separate issue from Road Safety. This however is not true. Traffic Accidents (as the PRESTIGE maritime accident but also the big fires in the Gotthard and Mont Blanc tunnels) constitute one of the major menaces to the environment, maybe bigger than the collective sum of use of oil for transportation.

Accidents cause serious bottlenecks and disruption to the transportation network. Even the simple novice drivers training at urban roads corresponds to roughly 2% of the everyday traffic volume. And, vice versa, the introduction of new types of fuels and vehicles may cause significant impact on traffic safety. For example, electric or hybrid vehicles that run silently up to a certain speed (when running on the electric motor, roughly up to 70 km/h for hybrids) may endanger pedestrian that didn't "hear them coming" or provide false concept of speed to novice drivers (i.e. IMMACULATE project results). On the other hand, eco-driving, due to low speeds and conservative nature, is also improving the proactive safety of the driver, so it is obvious that the connection between safety and environmental awareness is a working combination that will improve the twofold of accident reduction and CO^2 reduction immensely. Thus, road safety and environmental protection are the two sides of the same coin and can't be viewed in isolation.

There is a strong need to have a projects cluster on "Sustainable Safety" focusing upon:

- in a first row:
    - Collection, typology and in-depth analysis of Urban Accident data (of all types, including damage only ones), covering all transportation modes and with emphasis on those of vulnerable road users (pedestrians, bicyclists, PTW riders, …).
    - New concepts, materials and electronic measures towards self-explanatory road signing and forgiving road environments, including personalised and safe provision of road traffic (i.e. VMS/VDS) info to drivers and riders and safer road furniture.
    - Cooperative active safety systems focusing on specific challenges, such as pedestrians' protection, riders' safety, roundabouts, intersection and other black spots support.
    - Vulnerable traveller's compatible vehicle design, for the elderly; children and other fragile user groups, both as passengers or traffic opponents.
    - New tools, curricula and systems for long-life training of novice drivers, with emphasis on multimedia, driving simulators, VR/AR simulation tools and the use of new active safety systems (i.e. ADAS/ IVIS) as on-the-job training tools for driver behaviour improvement and promotion of eco-driving concepts.

- To further develop accident prediction models for a number of European countries slinking combinations of (elements of) road design, traffic and driver behaviour and to formulate criteria for benchmarking the safety performance of the different categories of roads in Europe.

- in a second row:
  - SAFETYNET II (IP)
  - Driver/ rider monitoring technologies and tools, to prevent accidents due to driver/rider inattention, excessive workload, fatigue, drowsiness, alcohol, illegal or medical drugs abuse (IP).
  - Joint research initiatives to optimise urban safety, mobility and environmental protection by new TMIC services and coordination of all traffic modes and participants.

ICT and eSafety intelligent car

- **Cooperative active safety systems** focusing on specific challenges, such as pedestrians' protection, riders' safety, roundabouts, intersection and other black spots support
- Quick method for assessing **nomadic** IVIS
- **Safety** and **eco-driving** ICT for **professional** drivers: HMI based upon human centred design
- Driver's **modelling** and simulation in ITS context
- **Elderly** drivers and long term effects of driver **assistance** systems
- Driver **training** and **ITS**
- Safety, Design and **appropriation** of **ADAS** functions, integrated methodologies for assessment
- **Integration** and **safety** of **nomadic** devices
- Effects of **ITS** on behaviour and **accidents**
- **Human Error** Management System to Improve **Road Safety**
- Focus on different **ITS user groups**
- Using theory to **design tools** to predict the distraction potential of in-vehicle technologies
- Using Distributed Interactive Simulation to Design and Evaluate **Cooperative ITS**
- **Intelligent Vehicle Dynamics**
  New vehicle concepts with alternative propulsion systems will open new opportunities for smart vehicle dynamics control systems. Research should be done to exploit, for example, the full potential of the adaptive control of electric motors on wheel-hub motor driven cars to influence lateral dynamics and further improve primary safety. The integration with existing driving dynamics systems has to be taken into account
- **V2V & V2I Communication**
  The possibilities to enhance road safety through V2V and V2I communication should be further explored. This includes the definition of vehicle requirements and system standards. A focus should be on infrastructure technologies, which can provide the vehicle respectively the driver with safety relevant information on the current status of the road infrastructure and the traffic situation. Cost benefit analyses of communication-based safety systems should be developed, as well
- **Reliability and Functional Safety of ICT-based Safety Systems**
  Safety system must offer full functionality when they are needed. Given the prolonged life cycles of modern cars as well as the growing complexity of safety-relevant electronics, securing the functionality of safety systems over the vehicle's complete life cycle forms a major challenge for the future. Software tools are now a key element to prove the dependability of electronic safety functions. Research should be done amongst others on new diagnostic standards and self-diagnosis as well as on the dependability of safety-critical software
- **FOT for Integrated safety and cooperative systems**.

Automotive safety

- **Detailed accident studies providing**
  - A base of documented reference cases for validation of simulation (including autopsies and in-vehicle Event Data Records)
  - Continuous monitoring of safety system performance to validate relevance of regulatory or consumer tests.

- **Biomechanical studies**
  - Data collection on human response and tolerance to impact for the development of biofidelic human models
  - identification of individual characteristics to optimize protection measures with smart restraint systems
  - Development of injury criteria and tolerance values for impairment (not only for life threatening injuries).
- **Refinement of test methods and tools**
  - Human models
    - Development of detailed models of human body for reliable response simulation and prediction of injury outcome
    - Constitute reference base of accident data for validation of simulations
  - Crash dummies
    - Upgrade of dummy capabilities to address all types of accidental situations and road users (instead of one dummy per impact type or road user category)
  - Virtual testing for innovative regulation
    - Reliability of numerical simulations from simple geometric tests to complex dynamic cases
    - Methodology for introduction of this technology in regulations.
- **Specific targets**
  - Pedestrians
    - We need a better understanding of accidents, especially the kinematics of the whole event. The severity of pedestrian accidents can come from the secondary impact on the ground while to day only the primary impact on the car is looked at
    - Should we use dummies or numerical models for this?
  - Elderly road users
    - Aging of population is a critical issue in many fields. As far as protection is concerned, the age effect should be introduced in evaluation tools (dummies or models). For instance, the effect of age on bone resistance to fracture is important. To be included in more general programs on age effect
  - Powered two-wheelers
    - specific evaluation procedure to test the effectiveness of protection systems (regulatory and consumer test)
- **Crashworthiness of vehicle structures** including
  - Compatibility for light urban vehicles (vs. big cars)
  - Compatibility with road furniture
- **Simulation Tools** for Integrated Safety Systems
- **Human Models & Active Dummies**
- **Test Methods** for Lighter Cars
- **Safety of Alternatively Powered Vehicles**
- **Simulation Tools** for Impact Analyses of New Materials
- **Adaptive Structures**.

<u>Preventive Road Engineering</u>
- Standards, measurement & testing
- Preparing for change
  - climate change, ageing population, etc
- Road markings, signing and signals
  - including VMS and road works
- Self-explaining roads (& tunnels)
- Infrastructure for all road users
  - including Traffic calming
- Winter maintenance

- Better surfaces.

H.2 – Rail safety

General
- Safety and security
  - Safety/Security management, Active and Passive safety, Multi-modal risk analysis/measures, Terrorism
- Human factors
  Human-machine-interaction and Human-computer-interaction, Anthropometry, Functional division between the person and the machine/computer and automization,
- Regarding the 3rd call of the 7th FP, the following subjects could be of importance:
  - (Remote) control of shunting locomotives
  - Innovative Driver
  - Safety Culture and Climate in the Railway and Airline Industries.

ICT and rail safety
- Intelligent mobility
  Telematics (Galileo), Intermodality, Customer information systems, Web based information systems
- Future thematic issues for breakthrough technologies, project ideas / abstract
  Some "Topics Examples" which are still research subjects:
  - how can we share same communication resources
  - how we can reconfigure communication resource in order to comply with new environment resulting of mobility
  - how to be "optimal" in the use of the information we are managing.

H.3 – Public transport safety

II.I - Advanced networks and traffic CO^2 management and congestion

I.1 – Road

- **Dedicated lanes**
  - For freight and "light" infrastructure for cars.
  - Systems for high-speed bus and taxi corridors
  - Effectiveness of separate lanes for road operations
  - Automated highways: systems for platooned vehicles
- **Advanced cooperative traffic management**
- **Advanced cooperative traffic control**
- **Adaptation and cooperative technologies for intelligent traffic**
- **Modeling and simulation road map elaboration**
  - Traffic modeling
  - Communication simulation
  - Behavioral models
  - Emissions models
  - Integrative models
- **Test beds and FOTs.**

I.2 – Rail

- **Operation and Systems Performance**
  Interoperability, Functional analysis, designing system architecture, Operations – planning and managing, Capacity management and optimisation = system performance
- **Intelligent mobility**
  Telematics (Galileo), Intermodality, Customer information systems, Web based information systems
- Future thematic issues for breakthrough technologies, project ideas / abstract
  Some "Topics Examples" which are still research subjects:
  - how can we share same communication resources
  - how we can reconfigure communication resource in order to comply with new environment resulting of mobility
  - how to be "optimal" in the use of the information we are managing
- **Advanced rail traffic management** and signalling Galileo/GPS, ERTMS
- **Interoperability**
  - Technical Specifications (TSI), Harmonisation, Standardisation, Modularisation (High Speed & Conventional Rail)
  - Optimisation of individual subsystems as part of an overall integrated rail system
  - Match operational, technical and customer needs in supply chain management, 3rd party logistics, real time management of customer information, and emergence of new technologies.

II.J - Industrial opportunities related to the European Economic Recovery Plan

J.1 – Road vehicles

- **Green car initiative towards the electrification of vehicles**
  - **Hybrid electric vehicles technologies**
    - Battery / ultra capacitor association: Ultra capacitors associated to batteries could improve battery life duration by insuring high transient power, mainly in recharge phases, while reduced-sized battery provides energy with an appropriate management to preserve its durability. Researches are needed to validate the feasibility and demonstrate the benefits of the battery/ultra capacitors association. Energy management with 3 sources (i.e. ICE, battery and ultra-capacity) requires research on generic management methods and multi-source systems.
    - Plug-in hybrid vehicles (PHEV) have a real potential to reduce CO^2 emissions, battery sizing and cycling representing however the key point of such a solution. The researches must deal with optimisation of the energy and the battery management together with parametrical studies of the appropriate battery type and size according to the vehicle use.
  - **Energy, raw materials, energy recovery in vehicles** (incl. manufacturing and recycling aspects):
    - Electric vehicles: an integrated deployment in connection with the others consuming sectors (heating, industry) and producing sectors (especially the possibilities for storing electricity from the volatile wind power.
  - **Future vehicles, future urban contexts**
    It should be useful to develop a future vision of the city and of the transport systems, with a significantly increased urbanization, a market of lightweight- (3-wheels, etc.) and electric-urban vehicles, new transports systems and services, adaptation to the future needs, and

developments of new transport strategies (car hiring, shared cars, etc.) as well as freight transport urban logistic.

Magnetic levitation transport system, at low speed in urban are currently studied in Korea, Japan, China. A research effort should be dedicated to such system for their overall advantages (electric-powered, low noise, no track wear, low visual nuisances).

. **"Radical changes"** (new technologies, strong evolution within short time period) require new tools and knowledge and models, as a number of issues have to be raised up and anticipated without experiences (economy, maintenance aspects, etc.).

- **Intelligent car initiative** (the proposals are similar to eSafety RTD WG)
  . Intelligent mobility service for people
  . Intelligent mobility service for goods
  . Intelligent vehicle systems
  . Cooperative systems
  . FOTs.

J.2 – Construction research needs

Rail infrastructure

Infrastructure Research to match growth in traffic density at a price to be competitive and to optimise rail network maintenance and traffic management

- **Track including sub-grade and rail**, "Switches, crossings", Level crossings, Wheel/rail interface, Signalling and control systems, Line-side equipment:
  . Track Design
  . Wheel Rail Interface
  . Condition Monitoring
  . Maintenance
  . Asset Management
  . Topic for Step changes: Semi-rigid track structures.

Road Infrastructure

- **Preventative Road Engineering**
  . Standards, measurement & testing
  . Preparing for change
    o climate change, ageing population, etc
  . Road markings, signing and signals
    o including VMS and road works
  . Self-explaining roads (& tunnels)
  . Infrastructure for all road users
    o including Traffic calming
  . Winter maintenance
  . Better surfaces
- **More efficient road maintenance techniques**
- **Infrastructure monitoring and maintenance management systems**
- **Maintenance of secondary network**

J.3 – Other modes: design enhancement

- **Rail rolling stock**
  Bogies and wheel sets, Power systems, supply and energy efficiency
- **Product qualification methods**
  Rail legislation and legal aspects, Assessment methods, Test procedures and facilities, Process of acceptance of railway products (e.g. cross acceptance procedures)

- **Encouraging Stepchange in Rail System Innovation**
  - Operators & Industries setting requirements and road maps and monitoring, selecting & disseminating innovative solutions according to their needs.

II.K - International cooperation

- **Here are the seven recommendations for international cooperation**:
  - Create enabling policies
  - Mobilize the human capital
  - Build collaboration mechanisms and joint programs including IPR
  - Systematically address the main barriers
  - Improve data management and sharing
  - Lay the groundwork for joint programming and funding
  - Facilitate common education and training.

- **The transatlantic cooperation or the cooperation in the economic triad are ready to start again**, including around the big challenges of the future.

- **The cooperation with the emerging countries** should be developed in the frame of win-win situations and targeted bilateral agreements.