Colophon

Editors
TNO
Mobility

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TNO develops knowledge and collaborates with industry to make this practicable. We find solutions today for problems that appeared unsolvable yesterday and we tackle the problems that will confront our customers tomorrow.

We take a multidisciplinary approach to complex issues, clustering knowledge form different core areas in groundbreaking research. We stimulate cooperation with other knowledge institutes both at home and abroad.

TNO stands for open innovation, sharing knowledge to create new knowledge. In this way we help people, organisations and the government to perform better.

TNO I Knowledge for business

TNO moving forward...

to safer, cleaner and more efficient mobility

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to safer, cleaner and more efficient mobility

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Ambition

Traffic jams, unpredictable journey times, traffic accidents, rising costs of logistics, energy consumption and pollution of the environment – they all combine to create the 'mobility' issue. It is an issue that has become increasingly more complex in recent years. We are using our knowledge and experience to work on new, effective solutions.

This book provides an impression of how we are contributing to cleaner, safer and more efficient mobility in Europe, helping our customers from concept to implementation and from engineering solutions to strategic advice.

Our knowledge is derived to a significant extent from European research programme projects that are vitally important to innovation in both the Netherlands and Europe. Acquiring knowledge in collaboration with the authorities, private parties and universities is the key to the power of innovation. For this publication we spoke with Mr Fabrizio Minarini (European Commission), Mr Martin van Gelderen (Dutch Ministry of Traffic, Transport and Water Management) and Mr Josef Affenzeller (AVL List GmbH, EARPA). They gave their own views of the centrality of European research, the results that have been achieved and a sketch of the challenges faced by society. My main conclusion from these interviews is that collaboration is at the crux of a better future.

The speed of technological development is accelerating all the time, problems are becoming increasingly more complex and more frequently need a multidisciplinary response. This demands a new kind of knowledge development and application. For long-term investments TNO consciously seeks collaboration with its strategic partners and that extends beyond participation in European research programme projects. Examples are the TÜV Rheinland / TNO Automotive International joint venture set up in 2008 to focus on crash testing. Also higher-risk participation in the development of new products like the Viapache, the first European traffic radar (for Vialis). Our membership mean that we contribute to the forming of strategic agendas, and we also track developments outside Europe through, for example, our membership of ITS Japan.

TNO focuses on three key issues within mobility:

1. Limiting the impact of traffic jams through a robust network, advanced traffic management, congestion levies and network interconnection.
2. Using ICT driven innovation to improve traffic flow, avoid traffic jams and significantly boost traffic safety.
3. Employing clean technology to reduce environmental pollution caused by traffic, with the current air quality problems solved within a decade and the longer term goal of alleviating the impact of traffic on climate change.

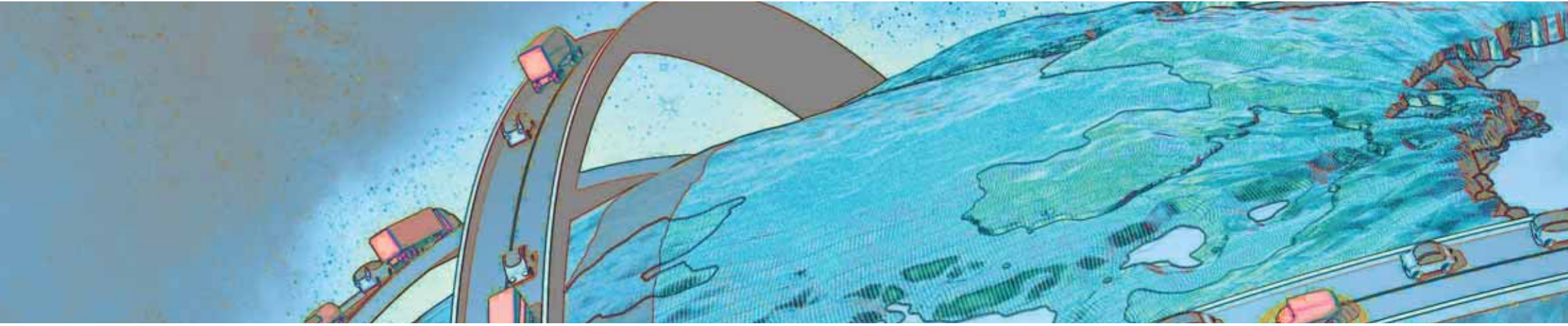
Our strength is in clustering vehicle engineering expertise, broad experience of ICT applications, knowledge of driver behaviour, the traffic system and emissions in a social context, including economy, habitability and spatial pressure.

This book outlines a large number of European framework programme projects in which TNO is involved. Our key people tell you more about the various themes, explaining how we arrive at a knowledge agenda and how we use the knowledge gained from these European projects for the benefit of our customers. The projects are in various stages and emanate from both the sixth and seventh frameworks. For more information from one of our experts, go to the knowledge page at *tno.nl* or visit the project websites.

For safer, cleaner and more efficient mobility you can count on the commitment of TNO.

I wish you plenty of inspiration.

Arie Bleijenberg
Manager Mobility
TNO



Martin van Gelderen
Dutch Ministry of Traffic, Transport and Water Management

European research through the EU framework programme projects are vital to innovation in Europe, giving industry, knowledge players, road authorities and others the financial means to acquire relevant knowledge. Knowledge that gains value through application in products or services.

While the results of the EU research programme are not easy to generalise, progress has been made in traffic in general and traffic safety in particular through the development of new technologies and test methods, later incorporated in legislation. This is not the case for all the projects, but that is the responsibility of the European Commission more than contract parties like TNO.

TNO is a reliable and knowledgeable partner; this is recognised abroad too. This is why TNO is often part of key projects and why consequently the Netherlands has a lot of knowledge, despite not having a major automotive industry. It gives the Netherlands a strong negotiating position.

The challenge confronted in many EU projects is application whereby establishing commonality among the various parties is central. For instance, a common platform on the use of ICT in road traffic (Intelligent Transport Systems) that can serve as a catalyst for the Dutch debate on the role and compatibility of vehicle and road systems. In the way Aprosys and VC-compat side and frontal impact tests can help inform the issue of updating international regulations.

Fabrizio Minarini
European Commission

European research policies and programmes are actually a legal and political obligation deriving from the Amsterdam Treaty. Research and technological development (RTD) is essential to enabling countries and companies to be competitive and provide employment. RTD also supports consumer and environmental protection. In short, the quality and relevance of RTD affects the individual and collective well-being of citizens.

The main objectives of European research are twofold: to improve the competitiveness of European industry and to contribute to the development and deployment of European policies. The results of the European projects will be mainly used by the participating partners, with dissemination to others taking account of intellectual property rights, and the European Commission will adopt the project recommendations in terms of policy.

The increasing complexity and expense of high-level research is in constant need of appropriate critical mass. Scientific and technological advances require cooperation and coordination at national and European level to overcome the fragmentation that exists. It is vital that Europe actively promotes and supports this, through organisations like TNO, a professional well prepared company that fulfils its contractual obligations arising from European Commission research contracts.

The main challenges for the future will be to reduce traffic congestion and emissions using ICT, to boost deployment and user awareness, reduce the size and cost of components and systems and boost traffic safety through cooperative vehicle to vehicle and vehicle to infrastructure systems and vehicle automation.

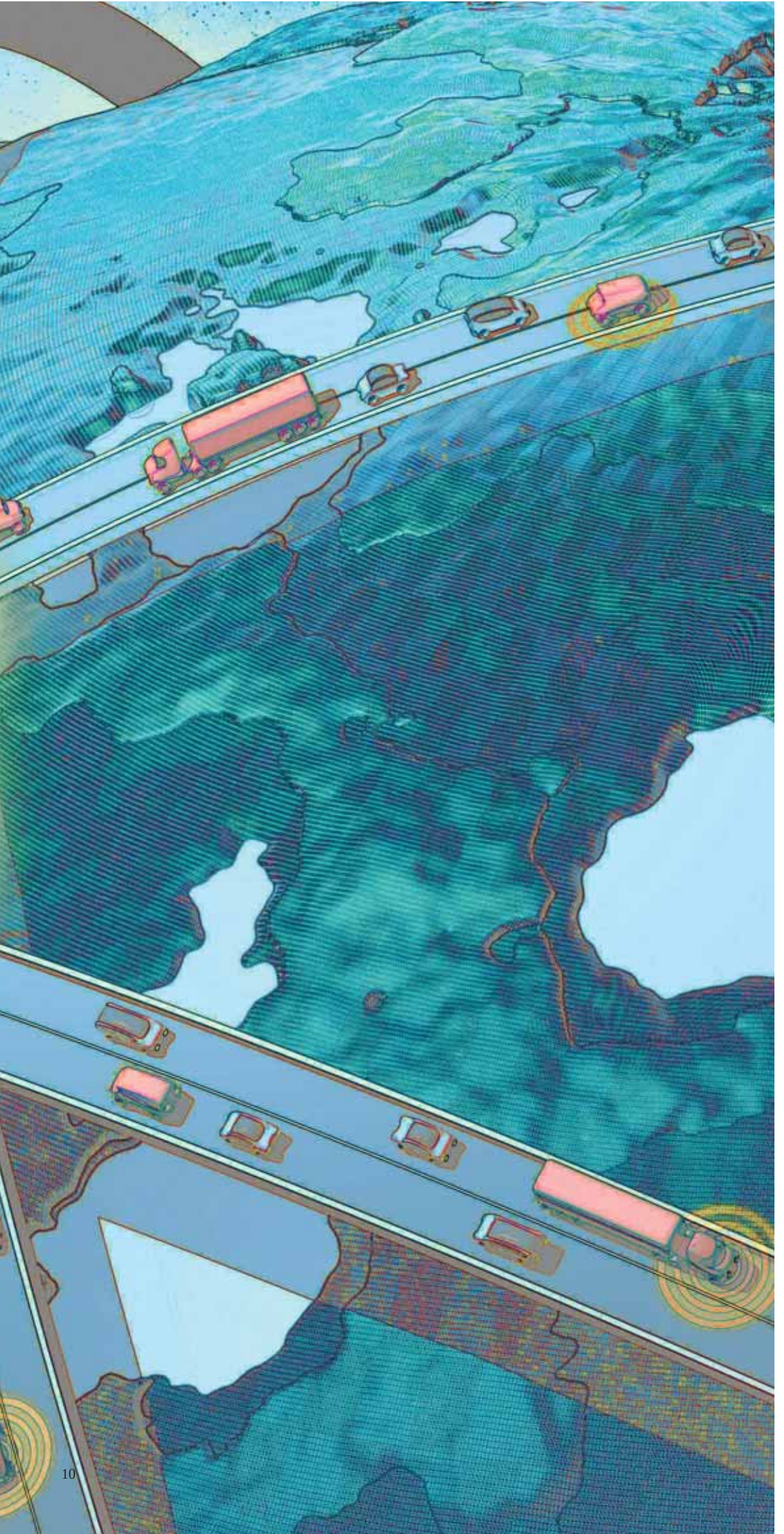
Josef Affenzeller
AVL List GmbH, Chairman of EARPA

European research represents important added value by providing a way for small and medium sized enterprises and less research-oriented production companies to gain development orientation and facilitating standardisation in electronic software development, creation of interfaces and the like. Furthermore, it is a networking exercise that generates common activities and long-term research partnerships in Europe.

For me, a key European research project result in terms of transport related projects was FURORE. Also the European Road Transport Research Advisory Council (ERTRAC) projects are important to passive safety and combustion technology development as well as the use of ICT in infrastructure and vehicles and potential solutions to urban noise issues.

AVL and TNO work together closely in the European Automotive Research Partners Association (EARPA) and have business relationships regarding specific software tools developed by TNO and now marketed by AVL, with positive mutual benefits.

The European transport sector today faces significant challenges in terms of reducing greenhouse gases, energy consumption and exhaust emissions, challenges that require a holistic response that includes new powertrain and vehicle technologies. Research is needed in embedded systems, biofuels and electrical power, especially for short-distance mobility, as well as standardisation, education and training for young engineers and the establishment of KIC activities in the European Institute of Technology.



Networks and memberships

International ambition and collaboration

The importance and influence of the European Union are increasing. This is due in part to European law and legislation and in part to the impact of the common market and emergence of a European knowledge infrastructure. TNO is active in many European research projects and is prominent in public and private contract research in the international arena. In Europe TNO is considered a ‘front runner’ together with its partners in the field of cooperative systems. We are a member of key European cooperation organisations like ERTICO, ECTRI, EARPA and eSafety FORUM. Moreover, we make a substantial contribution via various European networks and research platforms. TNO is also active outside Europe and has a network of offices worldwide. Our work in the field of mobility is predominantly focused on Japan and the United States. TNO has been a member of ITS Japan since 2008. Given the rapid and broad development of science and engineering as well as the global nature of different knowledge and product streams, TNO collaborates closely with universities and knowledge centres at home and abroad, and with the research departments of major companies. This enables us to keep our knowledge up to date and better respond to the questions of our customers. TNO participates in and contributes to:

ITS Netherlands connekt

ITS Japan

eSafety

ECTRI

ERTICO – INTELLIGENT TRANSPORT SYSTEMS AND SERVICES–EUROPE

earpa – European Automotive Research Partners Association

Logistics and intermodal transport

Arnaud Burgess

Kees Verweij

Logistics is inextricably linked to economic performance; the more efficient the transport and logistics, the more the economy benefits. Logistics is a chain with many players, involved both directly and indirectly. Arriving at the desired level of efficiency is complicated by a diversity of factors that include the economy, environment, modality and policy, not to mention the growing intensity of traffic and problems of capacity and congestion. It is clear that solutions, ones that are sustainable and have the least detrimental effects, have to be found through collaboration, cooperation and harmonisation. In other words, networking in the broadest sense.

The challenge to collaborate, cooperate and harmonise is evident in the initiatives being taken at European level, none more so than in the EU transport model projects that have resulted in the development, for instance, of TRANS-TOOLS, an IPR-free European standard. The modal shift that is taking place, in which the focus of co-modality is increasingly prominent, makes cooperation not only imperative but inevitable. TNO's contributions to achieving the solutions referred to above is to provide objective input – arguments for and against – for decisions. Not only through scientific and technological expertise but also through policy and organisational knowledge.

In the field of transport and logistics, TNO's work ranges from road to rail and involves developing models for both current and future scenarios, generating innovative and sustainable solutions, and facilitating the implementation of such solutions. An example of the facilitating role TNO takes in, for instance, the co-modality drive can been seen in the freight route initiative, developed in the RETRACK project, from Romania to the Netherlands where rail and road options are combined for the most efficient transport to get products from factory to shop.

IMPRINT-NET

Policy makers, transport operators, researchers and other stakeholders need a discussion platform to exchange views on the implementation of new pricing regimes, cost calculation methods for the derivation of tariffs to be levied and successful approaches to overcome barriers and influence attitudes and perceptions. IMPRINT-NET set out to provide this discussion platform.

The objective of IMPRINT-NET was to bring together relevant policy makers, other stakeholders and researchers to exchange information with a view to reaching consensus on the methods and results to be applied in setting tariffs for the use of transport infrastructure. IMPRINT-NET set out to facilitate, accelerate and increase the effectiveness of transport pricing reforms.

The result of IMPRINT-NET was the organisation of four expert groups meeting on pricing reforms for five different modalities and one on the use of revenues of the pricing. Ideally, assessing its ultimate impact amounts to measuring the extent to which it contributes to achieving the above. However this is not realistically feasible since the pricing reform implementation process largely depends on a variety of other factors like macroeconomic trends or policy decisions in other sectors on which IMPRINT-NET has little or no impact. Nevertheless, IMPRINT-NET has contributed directly to tackling current and emerging policy priorities and to overcoming the most significant barriers that appear to hinder the reform process, featuring a choice of topics for discussion and consensus building that reflect the current emerging policy priorities of the EU (streamlining the enlargement process, mobilising financial resources for the TEN-T) and of member states and transport policy makers (impact assessment, better understanding of the air and water modes). Debate and discussion formats have been designed to produce tangible output and a comprehensive dissemination plan has been drafted.

In IMPRINT-NET TNO was responsible for two expert groups on ‘Short Sea Shipping’ and ‘Inland Waterway Transport’ as well as organising four expert group meetings with individuals from the sector in which several pricing issues were discussed.

Coordination Action

2005 - 2008

TNO Budget/Total EC Budget: EUR 109.000 / 1.357.300

www.imprint-net.org

iTREN-2030

The TRANS-TOOLS model was developed as the EU's core detailed transport analysis tool. However, there is a need to create the linkage from TRANS-TOOLS to the following state-of-the-art tools: POLES (energy technology and energy prices), TREMOVE (environmental assessment and vehicle fleet development) and ASTRA (provision of the economic repercussions brought to bear by sectoral policies).

The basic objective of iTREN-2030 is to create that linkage and thereby extend the forecasting and assessment capabilities of TRANS-TOOLS to the new policy issues arising from the technology, the environment and energy. A key task is to generate a consistent baseline development until 2030 reflected by each of the four tools. This baseline, which will be compared with past projects, integrates and harmonises technological developments on the energy and transport front, energy prices and economic trends with demand for energy and transport coupled to their environmental impact. The match between the combination of tools and user needs for the forecasting and policy analysis of a large spectrum of energy and transport policies will also be revealed.

The main outcome of iTREN-2030 will be twofold: transport and energy scenarios in which the forecasts are quantified, consistent and accessible, covering transport, energy, environment and economy; four models that have a harmonised baseline, consistent reactions and are linked via standardised procedures. They will preserve the individual strength of the models and run through till 2030. Such a unique modelling tool for policy makers with its high level of consistency does not currently exist in Europe.

TNO is organising the first workshop deriving from the iTREN-2030 project, an extension of the TRANS-TOOLS model aimed to link the forecasting and assessment capabilities to the new policy issues. This workshop focuses on user needs and requirements from policy makers and experts in the fields transport, energy, environment, economy and technology. In addition, TNO is updating the TRANS-TOOLS logistics module.

Specific Support Action

2007 - 2009

TNO Budget/Total EC Budget: EUR 105.000 / 994.000

www.tmleuven.be/project/itren2030

PROMIT

European transport policy as well as national transport policies aim to increase the market share of more environmentally friendly transport modes (rail, inland waterway and short sea shipping integrated into intermodal transport alternatives). However, a lack of synergy and fewer opportunities for duplication or even multiplication of best practices run the risk of duplication of research or development efforts.

The aim of PROMIT is to foster the development of intermodal logistics through the promotion of successful logistics approaches on intermodal transport solutions and the collation, coordination and dissemination of existing and emerging research and industrial initiatives. The strategic PROMIT objective is to contribute to faster improvement and implementation of intermodal transport technologies and procedures and to help promote intermodal logistics and mode shift by creating awareness of innovations, best practices and intermodal transport opportunities for potential users as well as for politicians and for the research community.

PROMIT is gathering knowledge on best practices in an intermodal collaboration toolkit that can be used to guide consortia in setting up intermodal transport services. In addition, TNO is developing an intermodal benchmarking tool based on knowledge of key performance indicators to help consortia of shippers, logistics service providers or freight operators develop and implement intermodal solutions. With cooperation and mutual dependence central to success, a business model and organisation, with well defined roles and responsibilities, risk sharing agreements or service level agreements are crucial. The toolkit will facilitate the development and design of the business model and organisation.

TNO's role is to investigate the impact of the organisation and business model on the success of an intermodal solution, describing and disseminating good practices where particularly relevant. In addition, we are investigating the potential of benchmarking as a tool to stimulate the use of intermodal transport as well as looking at key performance indicators in intermodal transport and developing a benchmarking tool.

Coordination and Support Action

2006 - 2009

TNO Budget/Total EC Budget: EUR 164.000 / 2.808.600

www.promit-project.net

REFIT

To establish sustainability indicators and policy targets for transport requires tools, indicators and operational parameters to be developed for assessing sustainable transport and energy systems performance (economic, environmental and social).

The objective of the REFIT study is to provide a set of sustainability indicators for assessing the effect of various relevant priority policies/packages through state-of-art models at European scale. The challenge is therefore to develop, test and validate a modelling, tools-based methodology that produces data on a set of identified indicators and that enables ex-ante evaluation of the European Common Transport Policy in view of the economic, environmental and social dimensions of sustainability.

REFIT is a comprehensive assessment framework that links European transport policy objectives and indicators with tools and expertise accumulated within various European projects and contains a new evaluation module to produce data for policy targets and indicators that were hard to quantify. These are impact on regional development, (un)employment, competition between modes, exposure to noise and air pollution, personal health, transport safety, equity issues and income distribution. By providing a comprehensive and scientifically sound modelling, tools-based methodology that can assess the extent to which current transport policy contributes to achieving the ambition of sustainable transport, REFIT will help to make good judgements about alternative transport policy options, both for priority setting and for making good judgements about the sustainable impact. It will allow comparison (and selection) of various policy options and extend beyond the classical assessment of accessibility, emissions and congestion problems, through adding new evaluation modules to a general framework for sustainability assessment.

TNO has overall responsibility in REFIT for managing both the process and content of the project. Specific tasks are the development of a road safety model and an environmental model, which are incorporated as ad-hoc models to the core TRANS-TOOLS and TREMOVE models. All work is done at EU level.

Specific Support Action

2006 - 2008

TNO Budget/Total EC Budget: EUR 277.700 / 951.400

www.tno.nl/eu-projects

RETRACK

The European Union's (EU) transport policy aims for a transport system to meet society's economic, social and environmental needs through co-modality, i.e. the efficient use of different transport modes in a transport system, independently and in combination. This offers the best guarantee for a high level of mobility and environmental protection. The European Commission is thus stimulating the development and demonstration of new intermodal rail freight solutions in an effort to revitalise rail freight transport and improve its market standing.

The main objective of the RETRACK project is to develop, demonstrate and implement an innovative and market-tested rail freight service along the rail corridor between Rotterdam, the Netherlands and Constanta, Romania. This trans-European corridor is ambitious, with high potential for a modal cargo shift from road to rail, creating an effective and scalable freight corridor between high-growth areas in Western and Eastern Europe. This new rail freight service concept must demonstrate that trans-European rail freight services are a genuine competitive alternative to road haulage.

A commercially viable rail freight service that fits into the supply chain management (SCM) requirements of potential users, supported by innovative IT solutions, will enable seamless door-to-door transport. The option of multimodal door-to-door transport, including a very reliable, frequent and competitive rail freight service that is as easy to use as road haulage will benefit European shippers and logistics service providers. 'New' European rail freight operators will have the opportunity to transport a substantial volume on the Rotterdam – Constanta corridor and establish a viable rail freight service that integrates customers' SCM requirements. European society and citizens will benefit from an initial annual reduction of about twelve million transport kilometres and the Train Control Centre to be developed in RETRACK will result in much improved cross-border interoperability for rail freight services.

TNO is RETRACK project coordinator, responsible for the project and financial management. TNO acts as the spokesman in talks with the European Commission and also performs research on the logistics requirements for a rail freight corridor connecting West and East.

Integrated Project

2006 - 2009

TNO Budget/Total EC Budget: EUR 1.009.900 / 6.499.600

www.retrack.eu

SMART-CM

Efficient logistics is a key response to the pressures being exerted by the need to be more environmentally friendly and to gain greater service security.

The main objective of the SMART-CM, or SMART Container Chain Management, project in simple terms is to undertake a comprehensive review of the entire container door-to-door transport chain so that it can become more efficient, secure, market driven and competitive as well as more environmentally friendly. More specifically, the research is intended to facilitate the development, demonstration, and evaluation of new concepts and processes that will improve the efficiency, user friendliness, and quality of service of existing door-to-door container transport chains operating in different environments and conditions and using a range of technologies and organisational blueprints.

SMART-CM has set a number of specific objectives, including the development, testing and validation of a global architecture for container supply chain management. In addition, improvements and extensions to existing global standards for container transport will be proposed.

TNO is leading the work package that focuses on new requirements and logistics services for global container management. This work package contains three tasks, namely the state of the art of global container supply chain management (led by K&N), the creation of a SMART-CM implementation framework for global container surveillance and control with respect to user needs and requirements (led by DHL) and the drafting of a set of common requirements, with INTEGRITY (led by DHL).

Furthermore, TNO will be evaluating the economic and socio-economic results, analysing the financial benefits that result from the simplification of administration, including interfacing with Customs, and defining future scenarios of the socio-economic impact. Finally TNO will be developing an appropriate business model.

Collaborative Project

2008 - 2011

TNO Budget/Total EC Budget: EUR 303.400 / 6.499.600

www.tno.nl

TRANS-TOOLS

The main shortcomings in transport models included an unsatisfactory representation of the traffic mix (short/long distance and freight/passenger), a lack of intermodality and freight logistics in models, differences in the implementation of origin-destination base year for freight traffic in some models, the outdated character of some models (including both software approach, theoretical foundation and the data), insufficient linkage of network-based transport models with socio-economic and external effects, and limited feedback between network loads and travel speeds, and transport volumes.

As a result, the European Commission wanted to produce a new European transport network model that covered passenger and freight transport as well as intermodal transport. This would overcome the shortcomings of the existing European transport network models. The result was the establishment of the TRANS-TOOLS project whose aim was to produce a European transport network model that would generate solutions for the problems raised.

The TRANS-TOOLS model that was developed describes passenger as well as freight transport in Europe with all medium and long distance modes (cars, vans, trucks, train, inland waterways, ships and air transport). Covering the whole of Europe, the model is probably the largest transport model ever built in terms of number of countries, population and area being modelled. It is also one of very few models, describe that both freight and passenger transport. It has since become the accepted standard European transport network model.

TNO led the TRANS-TOOLS project, playing a major role in connecting the different sub-models and in developing the logistics module.

Coordination and Support Action

2006 - 2010

TNO Budget/Total EC Budget: EUR 350.000 / 1.500.000

www.inro.tno.nl/transtools

Traffic and information management

Frans op de Beek

André Oldenburger

One of the major challenges for traffic information management is deployment. In other words, getting the research into practice. A multitude of stakeholders and different vested interests cause a range of conflicts – legal, policy, commercial, consumer. What is needed is a roadmap that is created through collaboration in which industry and government agree on the objectives and priorities that will ultimately translate into optimum mobility. Indeed, collaboration and cooperation are key concepts in the development of systems to optimise vehicle-to-vehicle and vehicle-to-infrastructure (and vice versa) communication – the focus of ITS (Intelligent Transport Systems). The development of negotiating agents (to achieve adaptive controllers and green waves), decision support systems for network management, enabling better and more reliable traffic information, will result in improved traffic safety and flow and a reduction of environmental impact.

In order to achieve these aims, the EU framework programmes that centre on traffic information management are geared to the generation and exchange of knowledge in collaboration with stakeholders such as national road authorities whereby the technology is guided together with industry and government. For example, TNO supports field operational tests for government and industry that can serve as a demonstration of benefits and provide a stepping stone to commercial application. Given its unique and independent position between research and application and its considerable network that ranges across both private and public sectors, TNO is able to play a central role in efforts to harmonise and standardise initiatives and developments in an EU and global context. This will facilitate the creation of the essential roadmap and ensure that the solutions are both practicable and sustainable.

i-Travel

The problems encountered by travellers, content suppliers and service providers include the lack of integration and personalisation of information, most of which is inaccessible to the traveller during the journey itself and none of which detects and proactively informs the user of disruptive events. Additionally, content providers can only reach a small number of potential end users and service providers have to find and negotiate separately with a huge number of potential content providers. In the absence of technical and commercial standards, content and service suppliers are obliged to develop proprietary, 'vertical' solutions to deliver their products and thus provide a lock-in.

i-Travel is an original concept for the connected traveller. It combines a virtual travel assistant service that accompanies a traveller before and throughout each journey, providing personalised, context-aware information and support whenever wherever and however needed. This is based on integrating e-commerce and internet technologies to create the first business-to-business eMarketplace in the traffic and travel information services sector, allowing a wide-ranging community of content and service suppliers to connect to customers through i-Travel to serve new markets of travellers needing instant delivery of content and trip support.

Scenarios written to clarify and define the usage of the i-Travel system and the needs of the users and suppliers will facilitate the design of the i-Travel platform from a user centred perspective and make it easier to form a common view of user wishes and demands. Specific user needs will be deduced from the different scenarios and these will help determine the i-Travel agent and supplier needs. i-Travel is currently in a preparation phase that runs from 2008 to 2009.

Within Work Package 2 of the i-Travel project, TNO is responsible for the development of a framework and method to collect and present cases along with user and supplier needs that form the basis of the user requirements of the i-Travel system.

Collaborative Project

2008 - 2011

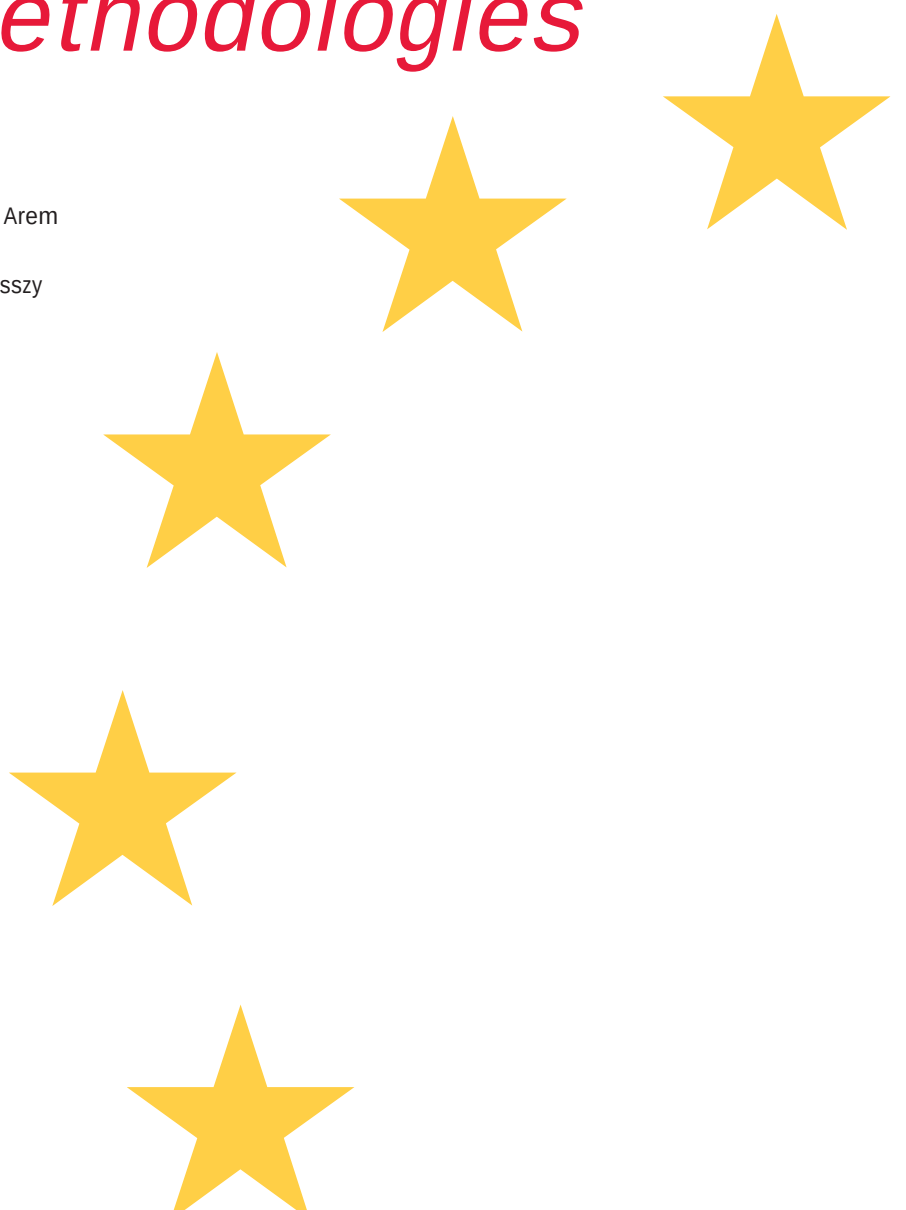
TNO Budget/Total EC Budget: EUR 88.800 / 2.288.000

www.i-travelproject.com

Models, tools and methodologies

Bart van Arem

Lorí Tavasszy



One of the major challenges faced by the EU in the development of its mobility policy in the EU is fragmentation. While there may be a multitude of parts, there is the lack of a whole. Harmonisation and standards are the key to enabling the new developments, in terms of both technology, policy and legislation, make a real impact and lead to cohesive mobility decisions. In the search for a common platform, there is a need for the stakeholders to co-define what the research needs are, how they can best be processed and how the results can be effectively implemented and managed.

The role of TNO in the debate can be defined as that of ‘architect’. The breadth and depth of expertise ranges from technological innovation to policy support. This knowledge is complemented and enhanced by the networks in which TNO operates, more often than not in a coordinating, supervising or initiative-taking role. By generating and providing models, tools and methodologies, TNO also helps to fill in many of the gaps in the mobility debate and reduce the many uncertainties that exist among EC and EU bodies. The models, for example, allow arguments one way or the other to be substantiated objectively. This is evident in the use of the TRANS-TOOLS model in forecasting the use of new international rail freight servicesimpact of the Iron Rhine rail link, for instance, or in models that can assist non-EU car manufacturers develop a traffic management strategy for the EU.

TNO is also working jointly with the European Commission and various research associations to develop create mobility roadmaps, taking account of the technology push and pull, mobility trends, the vested interests of various stakeholders from the road authorities and the traffic users to industry and government. This is where the added value of TNO really comes to the fore – being at the centre of developments, whether technological or legislative, knowledge and influence can flourish and real impact can be achieved.

FESTA

Field Operational Tests (FOTs) use quasi-experimental methods to evaluate functions under normal operating conditions in environments typically encountered by the host vehicle(s) and were introduced to prove that such systems can deliver real-world benefits. To support FOT designers in the design, implementation and assessment of FOT style experiments, there is a need for a good practice manual.

The FESTA Support Action is a vital step in the realisation of scientifically robust and efficiently run Field Operational Tests that aim to evaluate key ICT functions. It consists of the development of a best practice manual for the design and implementation of a FOT, including its entire lifecycle, from the analysis of stakeholder needs, the choice of behavioural and other (performance and individual) indicators, the methods by which they are measured (data acquisition) and analysed, reported and integrated to legal, ethical and procedural considerations.

The manual has a primary focus on the evaluation of Advanced Driver Assistance Systems (ADAS) and In-Vehicle Information Systems (IVIS) for both autonomous and cooperative systems. The manual is relevant to the evaluation of OEM, aftermarket and nomadic systems, and provides a common methodology for both European and regional or national FOTs within and outside Europe. It paves the road for standardising some aspects of FOTs, which could be helpful for cross-FOT comparisons. It provides a formalised and practical framework and not a cook book: the methodology described will have to be customised per case. The manual will provide practical guidance for applicants to subsequent ICT calls, enabling them to develop compelling FOT projects that fit into an integrated and coordinated programme of research.

TNO was a member of the steering committee and contributed to the work packages on a comprehensive framework of performance indicators and their interaction, experimental procedures, data analysis and modelling, and was task leader for social-economic impact assessment. Moreover, TNO contributed to writing the manual.

Support Action

2007 - 2008

TNO Budget/Total EC Budget: EUR 142.800 / 2.113.300

www.its.leeds.ac.uk/festa

eIMPACT

The contention that IVSS can boost the effectiveness of the transport system by improving road safety, traffic flow and comfort for users has already been evidenced by several systems while others have shown plenty of promise in trials. However, to determine the socio-economic acceptance and implementation of such applications, a cost-benefits analysis was done on the impact of IVSS over the next ten to fifteen years.

The eIMPACT project aims to estimate the penetration rates of IVSS in 2010 and 2020 as well as the traffic and safety impact of these systems in the EU. This socio-economic impact assessment involved identifying the most promising stand-alone and cooperative IVSS technologies, developing market penetration scenarios and estimating impact on traffic safety and efficiency, with detailed results for 2010 and 2020.

The impact assessments of twelve stand-alone and cooperative systems for 2010 and 2020 have generated safety impact statements for reductions in fatalities, injuries and accidents, direct traffic effects (traffic flow) and indirect effects (reduction in congestion) as well as cost-benefit analyses for the twelve systems supplemented with a stakeholder analysis that examined the costs and benefits incurred by users, industry and public authorities. Finally, the options were explored for IVSS deployment policy and strategy. The results are contained in a final report on the integration of results and prospects for the market introduction of IVSS. The project was rounded off with a final conference and an operating plan.

TNO not only coordinated the EU's Intelligent Vehicle Safety Systems (IVSS) project but also led the Impact Assessment work package, eIMPACT. TNO's ITS Modeller estimated direct traffic impact, such as travel times and speeds, while empirical data, literature reviews and expert judgment formed input to the safety impact assessment, measured in terms of reduced fatalities and injuries.

Specific Targeted Research Projects

2006 - 2008

TNO Budget/Total EC Budget EUR 544.000 / 2.500.000

www.eimpact.info

FOT-Net

There is a clear need for the establishment of an EU network for public and private stakeholders on the testing and evaluation of Field Operational Testing (FOT) activities at EU, national and local scale. This involves the dissemination of the methodologies for testing and evaluation that have been researched and proposed in the FESTA project.

FOT-Net's prime goal is to establish a support action for strategic interaction and networking of existing and future national, European and global FOTs (e.g. US and Japan). The action should include all stakeholder groups that play or will play an active and requisite role in existing and future national, European and global FOTs.

A European networking body for national, European and global FOT activities will comprise representation from all stakeholders from public and private sectors. The main aim will be to boost the significance, visibility, comparability and transferability of available FOT results at national and European level as well as promote the implementation of a common FOT methodology (FESTA results). Networking will enable access to European organisations with an interest in FOTs and help in the development of new partnerships. In addition, further insight will be gain into the practicabilty of the FESTA methodoly. This will be complemented by an extension of the TNO toolsuite for testing and evaluation activities to incoporate, for instance, tools for the dissemination of FESTA results.

TNO is leader of the 'Networking and interaction process' work package that is focusing on dissemination of methodologies for testing and evaluation of in-car systems in Field Operational Tests. The methodology was developed in the FESTA project (EC KP7 2008) and the dissemination is being facilitated through the organisaion of seven seminars and supporting activities (web forum, networking activities) directed to the FOT community at EU, national or even project level.

Support Action

2008 – 2010

TNO Budget/Total EC Budget: EUR 145.400 / 1.230.000

www.fot-net.eu

PREDRIVE C2X

Traffic safety, congestion and environmental impact need more attention than ever within the EU. While intelligence and cooperative systems are regarded as promising solutions, and plenty of simulation tools and models are available, a standard methodology and architecture for simulating new cooperative applications is missing. This deficit is caused by the lack of a suitable integrated simulation environment dedicated to vehicle-to-vehicle and vehicle-to-infrastructure communication technology. A tool is needed that combines both worlds.

The objectives of PREDRIVE C2X (PREparation for DRIVing implementation and Evaluation of C-2-X Communication technology) are to create and apply a dedicated tool set that allows the complete interacting system of vehicle traffic, communication and application to be evaluated. Simulation will show the effects of various C2C (car-to-car) applications on traffic safety, traffic flow efficiency and alleviate the environmental impact of traffic. It will point to the driver assistance and assistance systems as well as new kinds of traffic services that are possible through C2C.

The project will result in a tool set for simulating the complete system for a C2X application. TNO will 'link' the available and developed models on a standardised platform for simulation using various simulation tools. By generating a common approach to simulating cooperative systems, and specifically testing and validating applications on different levels of detail using sub-micro, micro or macro simulators, these simulation tools can be interfaced on a platform that is able to add driving simulators or HIL (hardware in the loop) facilities. This enables different stakeholders to validate the effects of new innovative applications for their specific field of interest.

TNO will actively contribute to work package '2000: Simulation' to create and apply a dedicated tool set for the simulation of vehicle traffic, communication and application. By identifying the needs of the decision-making process and impact assessment of cooperative systems, the simulation models will define the corresponding architecture for connecting the various models.

Specific Targeted Research Projects

2008 - 2010

TNO Budget/Total EC Budget: EUR 62.800 / 188.900

www.tno.nl/eu-projects

Integrated safety

Richard van der Horst

Ton Versmissen

Safety is a vital element in mobility. The long-term targets to reduce fatalities and severe injuries are both ambitious and necessary, especially as there seems to be no end to the exponential growth of road traffic. Road and vehicle safety can be classified as passive (during impact) and active (pre-impact). With a focal shift from passive to active safety, which involves the incorporation of human factors, comes interaction between the driver and his environment, between the vehicle and the infrastructure. This is prompting a trend towards the integration of passive and active safety; an integral systems approach that takes account not only of technological development and innovation but also of user aspects, legislation and policy. Hence the many EU programmes and projects whose results are aimed at translating goals and objectives into tangible application.

TNO is at the very heart of many of the projects that focus on passive and, more and more, integrated safety. With a multidisciplinary structure and specific expertise in road safety coupled to a significant network in both private and public sectors, TNO is perfectly positioned to play an important role in many of the EU projects. TNO's involvement covers the entire road safety spectrum, from developing methodologies to designing, testing and evaluating new, innovative safety components and systems. Field operational tests are a key component of the approach as are manuals and guidelines, for example for human-machine interface applications or the effective use of roadside furniture. Participation in EU projects also helps support initiatives being taken by industry and government and, importantly, in linking their objectives so that sustainable, integrated safety solutions are produced that will ultimately benefit the end consumer.

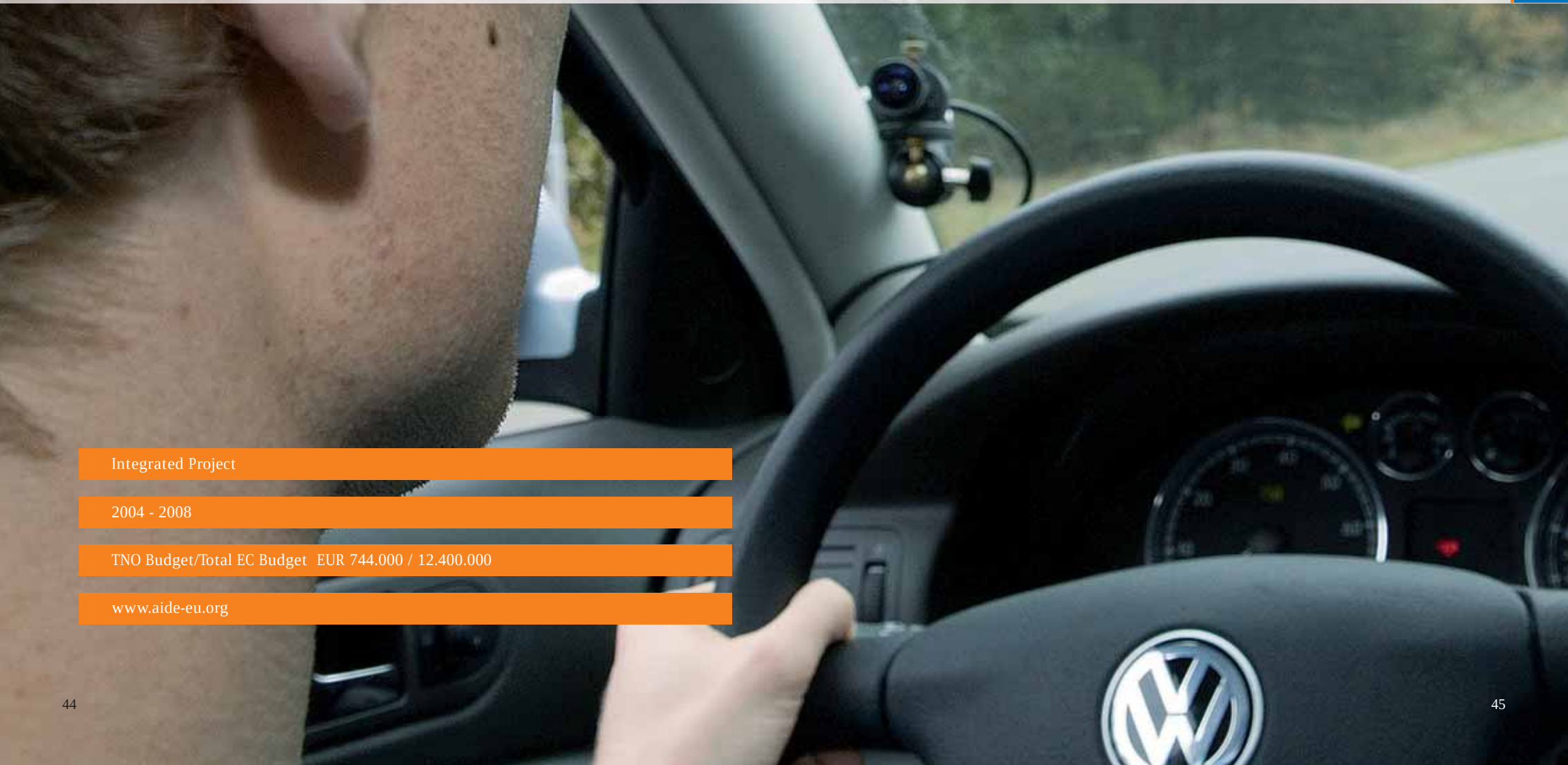
AIDE

A wide range of new in-vehicle technologies are being introduced, including Advanced Driver Assistance Systems (ADAS) and In-Vehicle Information Systems (IVIS), along with in-car nomad devices. While these technologies have great potential for enhancing road safety, their benefits may be significantly restricted by unexpected behavioural responses.

AIDE targets maximising the efficiency and safety benefits of advanced driver assistance systems and minimising the level of workload and distraction imposed by in-vehicle information systems and nomad devices. The aim of the 'Evaluation and Assessment Methodology' sub-project was to develop a cost-efficient and industrially-applicable methodology for quantifying effects related to road safety and for extending existing approaches, taking account of new adaptive integrated interface solutions, new ADAS and nomad devices.

The AIDE IP generates knowledge and methodologies as well as human-machine interface technologies required for the safe and efficient integration of ADAS, IVIS and nomad devices into the driving environment. The sub-project results specifically include a generic methodology for industrial HMI evaluation with respect to road safety and validated AIDE prototypes. AIDE has resulted in a major breakthrough in HMI for in-vehicle applications. The integrated approach adaptive to drivers' momentary needs and capabilities has proven to be beneficial for workload, distraction and road safety. The AIDE results also allow the government to play its regulatory role for in-vehicle and nomad devices. The knowledge gained is of direct benefit for the development and testing of user-friendly, future cooperative road-vehicle systems for both vehicle-vehicle and vehicle-infrastructure communication capabilities.

AIDE is an integrated project (IP) organised into four sub-projects, each containing work packages. TNO was responsible for the sub-project 'Evaluation and Assessment Methodology' as well as being a member of the AIDE core group and leader for the 'Management' and 'Estimating Risk Reduction Potential' work packages. Furthermore, TNO co-compiled the AIDE guidelines on performing adaptive Human Machine Interaction, or HMI, evaluations, conducted several driving simulator experiments and evaluated the luxury car AIDE prototype.



Integrated Project

2004 - 2008

TNO Budget/Total EC Budget EUR 744.000 / 12.400.000

www.aide-eu.org

APROSYS

In spite of significant improvements in vehicle safety over the past 25 years, the current number of deaths and injuries as well as social and economic costs are still unacceptably high. While passive safety has proven to be a very effective strategy to reduce the number of casualties among road users, vehicle safety experts agree that significant further reductions in fatalities and injuries can (and should) be achieved by using passive safety strategies.

APROSYS will help significantly reduce road victims and increase competitiveness in Europe by developing new critical safety technologies (safety is a proven selling point) along with design tools and evaluation methods. The key objectives are new injury criteria and tolerances, new mathematical human body models, new global harmonised crash dummy, new knowledge and tools for intelligent safety systems, enhancement of virtual testing technology, new test methods (for advanced safety systems) and advanced protection systems for injury reduction in relevant accident types.

The results will include human body models (including brain models), the worldSID fifth harmonised dummy, side impact system, a generic assessment methodology for adaptive safety systems and generic car models, virtual testing, test methods for vulnerable road users, more realistic frontal impact test, side impact test methods and new protection systems. These test procedures provide a very good tool for regulatory bodies in assessing new safety devices and methodologies, both active and passive, and new protection systems will directly benefit the European road users. Human body models and developments in virtual testing offer huge advantages for future R&D in automotive safety.

TNO is coordinator of this large-scale integrated safety project contributing to the full spectrum of improving safety for car occupants (car to car and car to heavy vehicle impacts), vulnerable road users (impact with both cars and heavy vehicles) and motorcyclists (impact with cars and road furniture), and performing a wide variety of tests, simulations and analyses, including developmental work on new test procedures and tools.

Integrated Project

2004 - 2009

TNO Budget/Total EC Budget: EUR 4.500.000 / 30.000.000

www.aprosys.com

APSN

The number of people being killed on the road is simply too high. While we can look at a variety of strategies for changing that - better roads, better brakes and the like - these measures are aimed at stopping accidents from happening in the first place. However, if we assume that accidents will still happen, then we have to look at strategies for minimising the damage.

This is where the APSN comes in. The aim of APSN is to mobilise European scientific and business expertise in vehicle passive safety to accelerate improvements in road safety and thus reduce the number of annual road victims in the European Union. The APSN joint technical and scientific objective is to enhance the level of road safety at an affordable cost for the individual user as well as for European society. The ultimate goal of the network is to build a self-sustaining virtual institute that will be a self-sustaining entity able to continue the work of APSN.

The ASPN has brought together the main R&D centres for passive safety research in Europe in a network to integrate research activities, identify 'white spots' and initiate new RTD projects. In addition, by facilitating technology transfer and knowledge 'brokering' as well as accelerating the dissemination, harmonisation and implementation of the results gained through research and development, the ASPN is contributing to future vehicle safety strategy and encouraging collaboration among OEMs, suppliers, research organisations, universities, insurance companies and the SME sector. Tangibly the work ahs generated 19 new joint EU projects, 50 workshops, 40 state-of-the-art reports, six conferences, a website + Intranet, links to stakeholders and an R&D roadmap.

TNO is the network coordinator and is responsible for organisational and administrative support such as information management, network administration and contractual aspects.

Network of Excellence

1998 - 2008

TNO Budget/Total EC Budget: EUR 200.000 / 10.000.000

www.passivesafety.com

COST358

People walk, whether by need or choice. The quality of their experience may vary greatly and this, in turn, is known to directly affect their decisions on choosing to walk against other modes. It also affects the frequency, length, scope and enjoyment of their trips. What do people need for safe, agreeable mobility in public areas and how can systems approach be of greater added value compared with sectoral approaches?

The Pedestrians' Quality Needs (PQN) project has been established to identify these questions, the main objective being to provide knowledge of pedestrians' quality needs and how those needs relate to structural and functional interventions, policy making and regulations in order to support conditions for walking across the EU and other countries involved in the project.

The envisaged results of the project include improving the understanding of how public space, the transport system and the social, legal and political contexts relate to pedestrians' quality needs as well as boosting the effectiveness and efficiency of future policy and research through a new and coherent system of concepts, theories and models that influence the quality and provision of pedestrian facilities. Furthermore, an accessible knowledge base and easy-to-use auditing tools will enable relevant organisations to work together to identify, prioritise, tackle and prevent current and future restrictions on the full potential for pedestrians. By providing access to and sharing international knowledge on pedestrians' quality needs as well as practical tools to improve and promote walking, sound scientific European research will strengthen the position of vulnerable road users.

TNO is a management committee member and is participating in the Functional Needs and Perceived Needs working groups, exploring the needs of pedestrians and developing evidence-based contextual models, with measurable output. TNO focuses on the functional capabilities of humans, the definition of groups and on individual, perceived physical and perceived social environmental factors related to walking.

COST

2006 - 2010

TNO Budget/Total EC Budget: EUR 240.000 / 9.000.000

www.walkeurope.org

DRUID

The ambitious goal to reduce the number of victims in road traffic has to take account of factors that affect performance of both the vehicle traffic system and the driver. Awareness of societal changes – a new emerging youth culture searching for new experiences in the context of an ageing society with increasing need for medicines amid exponentially increasing mobility – is not enough. We urgently need to boost our knowledge about the impact of psychoactive substances on traffic safety.

DRUID deals with the scourge of drunk-driving and is searching for answers to questions concerning the use of drugs or medicines that affect people's ability to drive safely. It brings together the most experienced organisations and researchers in more than 20 European countries. The aim is to gain new insights into the real degree of impairment caused by psychoactive drugs and their actual impact on road safety to generate relevant harmonised, EU-wide regulations.

Establishing guidelines and measures to combat impaired driving caused by alcohol, illicit drugs and medicines as well as psychoactive substances will give scientific support to EU transport policy to achieve the 2010 road-safety target. Experimental studies will identify how drugs impair cognitive and psychomotor skills and establish associated drug concentrations. Both are highly relevant to EU countries that are developing drug-driving legislation based on either a drug-threshold approach similar to alcohol or the impairment approach.

As one of the partners in the project, TNO is conducting laboratory research and a driving simulator study to assess the effects of drugs and/or alcohol on driving performance under experimental, placebo-controlled conditions. By participating in DRUID, TNO is supporting the government's efforts to deal with the issues of legislation, prevention, penalisation, medicine-labelling and "good practice" for detection and the training of road traffic police in the legal monitoring of drivers.

Integrated Project

2006 - 2010

TNO Budget/Total EC Budget: EUR 194.200 / 24.000.000

www.tno.nl/eu-projects

PISa

Of the almost 40,000 persons killed every year on EU roads, about 6,500 are drivers and passengers of motorcycles, mopeds and other Powered Two Wheelers (PTW), which implies a twenty per cent higher risk of death per kilometre travelled than cars. The safety of vulnerable road users, including motorcycle and moped riders, is one of the priorities of the European Community as stated in the White Paper on Transport Policy 2002-2010. In India the incidence of PTW related deaths is much higher in view of the high volume of PTW sales.

The aim of the PISa (Powered two wheeler Integrated Safety) project is to develop and use new technologies to provide integrated safety systems for a range of powered two wheelers. This will not only greatly improve primary safety but also link to secondary safety devices. The systems will be reliable and fail-safe as well as improve the performance and safety of the vehicles. PISa will contribute to the general EU target of fifty per cent reduction in road accident fatalities as well as to India's automotive policy by enhancing the safety of PTW designs.

The development of sensors and actuators and their integration into an operational safety system will allow driver warning and assistance as well as improved handling and stability. The incorporation of these systems into PTWs will be evaluated by road and track tests together with simulations. PISa will thus contribute to the general EU target of reduction in road accident fatalities.

Two business units represent TNO involvement. The main task of TNO Automotive is the technical coordination of the entire project and responsibility for selecting of the sensor set, developing a motorcycle state estimator and final simulation of the whole system. TNO Human Factors is playing a major role in analysing accident video data and specifying driver assistance functions. Furthermore, this unit is responsible for developing part of these functions.

Coordination and Support Action

2006 - 2009

TNO Budget/Total EC Budget: EUR 621.300 / 2.944.000

www.pisa-project.eu

REACT

The long-term vision of reducing traffic deaths significantly and improving transport infrastructure efficiency requires state-of-the-art technologies that can generate safety alerts along with speed and route recommendations that are communicated to individual vehicle drivers as well as provide relevant information for road and law enforcement authorities. Time for REACT.

REACT is a project that uses mobile vehicle sensors that detect driver behaviour and condition. REACT can send a warning to the driver, raise his vigilance and so reduce the risk of an accident as well as share data and results with existing systems and operate in close coordination with regional road authorities. The project's four key objectives are to develop real-time mobile sensors that measure natural and infrastructure conditions, a method for generating in-car recommendations to the driver based strictly on data from the vehicle's in-car sensors, state-of-the-art secure communication capability and analysis, prediction, and decision-making models in a central server. The Munich region is the location for field tests of the prototype system.

REACT is helping to create a traffic management system with the potential to reduce traffic fatalities, increase road transport efficiency and facilutate greater standardisation and harmonisation throughout Europe. The achievement of REACT's technological objectives will make it possible to obtain a comprehensive picture of real-time transport on all roads through ubiquitous mobile sensors, to monitor safety risk factors and driver activity. Analysis and prediction will lead to intelligent recommendations and information for authorities that will significantly reduce traffic fatalities and increase transport system efficiency. In time, the system will provide useful input for planning transport network extensions.

TNO has developed one of the required sensors for the traffic management system, a friction monitor, which indicates the friction level of the road. This data can be transmitted to the traffic manager and processed for safety and efficiency. In addition, TNO has been participating in the project's communication system and in the field test by providing a vehicle equipped with the friction sensor.

Specific Targeted Research Projects

2005 - 2006

TNO Budget/Total EC Budget: EUR 335.000 / 3.680.000

www.react-ist.net

VC-COMPAT

Traffic-related accidents are still a major hazard in the European Union, especially given the annual road toll of more than 40,000 people killed (more than half car occupants) and 1.6 million injured, which represents an unacceptably high burden on Europe's society and economy. These accidents currently cost an estimated 160 billion euros per year in the European Union alone. Following the introduction of the frontal and side impact directives in October 1998, compatibility offers the next greatest potential benefit for improving car occupant safety and reducing road casualties.

The ultimate aim of the vehicle-to-vehicle crash compatibility project is to develop a suite of crash test procedures that, once implemented in legislative or consumer testing, will improve vehicle crash compatibility and reduce the number of serious injuries and fatalities by as much as a third in accidents where a car collides with another vehicle. In addition, structural changes necessary to the car for improved compatibility are expected to increase protection in many single vehicle accidents and reduce the number of fatalities caused by car-to-truck frontal collisions when trucks are equipped with a rigid or energy-absorbing under-run device.

The proposed work will form a major contribution to the development of a suite of test procedures and the consequent improvement in vehicle frontal impact crash compatibility. A subsequent reduction in the number of killed and seriously injured car occupants by as much as thirty per cent in accidents where a car collides with another vehicle is expected. The results of the project will also benefit MADYMO car and barrier models for numerical fleet studies.

TNO's involvement in the project included research into fleet optimisation studies, engineering of test methods for car-to-car, accident analysis and project management for the car-to-truck component. The engineering component includes both numerical crash simulations and experimental testing.

Specific Targeted Research Projects

2003 - 2006

TNO Budget/Total EC Budget: EUR 1.400.000 / 8.400.000

www.vc-compat.rtdproject.net

Greening of surface transport

Hans Driever

Foort de Roo

Mobility and the environment have become inseparable from each other. Future mobility will have to be quieter, cleaner and more energy-efficient, which demands innovative solutions not just in the technological sense but also in terms of the various processes that contribute to achieving environmental objectives. These solutions concern the entire chain, from source to destination. In turn, this requires a multidisciplinary approach and the participation of the respective stakeholders in respect of policy and legislation, and their acceptance. Without this, a sustainable mobility is unconceivable. The EU has set a number of ambitious environmental targets, such as the significant reduction of CO_2 traffic emissions in the longer term and of particulate matter and NO_x in the shorter term. The three key areas are noise, air quality and CO_2.

In tackling the problems of mobility and the environment, the importance and influence of the EU are increasing, in respect of policy and legislation, on the one hand, and commerce and knowledge, on the other. The European framework projects that relate to mobility and the environment require a collaborative approach. TNO's independence and position in a variety of international networks and in collaborative ventures makes TNO a key participant, contributing (and deriving) knowledge and innovation across a broad spectrum, from technology to legislation. With a multidisciplinary, integrated structure, TNO is active in a range of activities, including the development of new technologies and improved applications for biofuels in the EU, the co-development of hybrid system for trucks and advanced models for the prediction of sound propagation over large distances where wind and temperature effects dominate the noise impact of surface and air transport. In addition, an urban strategy decision support system developed by TNO will enable policymakers to see the impact of measures on local habitat (like traffic flow, noise, air quality, safety, accessibility, green areas and groundwater).

BEST

In recent years, it has become perfectly clear that the world's reliance on fossil fuels for transport is unsustainable. The days of cheap and easily available oil are numbered. In addition, the impact of fossil fuels on global warming has to be tackled not tomorrow but now. Of the alternatives, one of the most promising is bioethanol.

BEST (Bioethanol for Sustainable Transport) is a joint effort between ten strategically chosen sites in Europe and the rest of the world, as well as a number of key market participants, to encourage an extensive substitution of petrol and diesel by bioethanol. For bioethanol-fuelled vehicles to become viable, convenient alternatives for regular consumers, an infrastructure supporting these vehicles – car-makers selling the cars, fuel-producers making the fuel, and fuelling stations providing it – has to be in place. BEST's goal is to help such an infrastructure emerge on a very practical, local level by stimulating the market for bioethanol-fuelled vehicles. In concrete terms, BEST will help the participating markets to develop so that a market breakthrough occurs and the market becomes self-supporting.

During the project more than 10,000 ethanol cars and 160 ethanol buses will be put in operation. E85 and E95 fuel stations will be opened. Low blends with petrol and diesel will be developed and tested. Through this the participating cities and regions aim to prepare a market breakthrough for ethanol vehicles and for bioethanol and also to inspire and obtain followers. Rotterdam is one of the pilot cities. Two pilots will be conducted with biofuels. Knowledge will be derived about different sorts of biofuels, for instance, their effects on cars and the environment as well as potential barriers to use. The knowledge can be used as input for policy making.

TNO is one of the participants in the project and will be monitoring and evaluate these pilots in Rotterdam as well as acting as an advisor on biofuels for the Rotterdam municipal authorities.

Integrated Project

2006 - 2009

TNO Budget/Total EC Budget: EUR 450.000 / 10.000.000

www.best-europe.org

BiogasMAX

In its efforts to reduce dependency on oil, greenhouse gases and direct emissions, the European Union needs support. One of the ways of providing this support is to generate knowledge about more efficient production, distribution and use of biogas in the transport sector sourced from a wide variety of feedstock available in urban areas and regions in Europe.

The aim of the EU's Biogas MAX project is to demonstrate the applicability of biogas for vehicles. In order to demonstrate this, several aspects of biogas fuel use must be identified: technical reliability, cost-effectiveness, environmental and societal benefits. The purpose of performing large-scale demonstrations is to optimise industrial processes, experiment and benchmark new and near-to-market techniques, and expand biogas fleets. In addition, ways to remove technical, operational and organisational/institutional barriers, which may inhibit or prevent the introduction of alternative engine fuels and energy-efficient vehicles, must be identified and assessed. This knowledge must then be disseminated to European cities and stakeholders, with an emphasis on the newer member states, so as to enhance the market acceptance of biogas as an alternative motor fuel.

The result of this project is to be found in demonstrating the use of biogas in vehicles as a tangible product of a strong research programme in response to the EU policy objectives to replace twenty per cent of petroleum-based fuels in the transport sector. The replacement ratios will be five to eight per cent biofuels, ten per cent natural gas and two per cent hydrogen.

TNO's role in the Biogas MAX project is to investigate the impact of using biogas fuels in engines, in particular the influences on exhaust emissions, catalyst efficiency, engine performance and engine.

Integrated Project

2005 - 2008

TNO Budget/Total EC Budget: EUR 190.000 / 7.500.000

www.biogasmax.eu

CIVITAS POINTER

How can cities achieve a more sustainable, clean and energy efficient urban transport system by implementing and evaluating an ambitious, integrated set of technology and policy based measures? That is the issue that the CIVITAS (CIty-VITAlity-Sustainability) project aims to tackle. The EC wants to ensure that the implementation of ambitious integrated sustainable urban transport strategies make a real difference for the welfare of the European citizen. So support and evaluation are essential.

The aim of CIVITAS POINTER project is to support the monitoring of the demonstration projects and cities by helping to guide the monitoring process via standard management tools. It strives to help all the CIVITAS Plus cities to understand the importance of data collection and evaluation as well as help the cities in a practical way with all work on evaluation. This will be achieved by setting up practical guidelines for data collection, helping with the ex-ante evaluation, communicating in a direct way with the cities through organising workshops. Furthermore, CIVITAS POINTER will undertake a cross-site evaluation for CIVITAS Plus based upon all the data collected by the cities.

The CIVITAS POINTER project will disseminate best practices in monitoring and evaluation and will develop evaluation methodologies that will also be used in other large-scale (EU) projects. All the information will be translated to policy recommendations at EU level. These results and lessons learnt in evaluation will be disseminated for further use in other major EU projects.

TNO is coordinator of the project and has a very active role in work package 2 whose main objective is to ensure that the evaluation activities within the individual cities and projects are performed correctly. TNO is also contributing to the work package on policy assessment and recommendations as well as the work package on best practice experience in monitoring and evaluation.

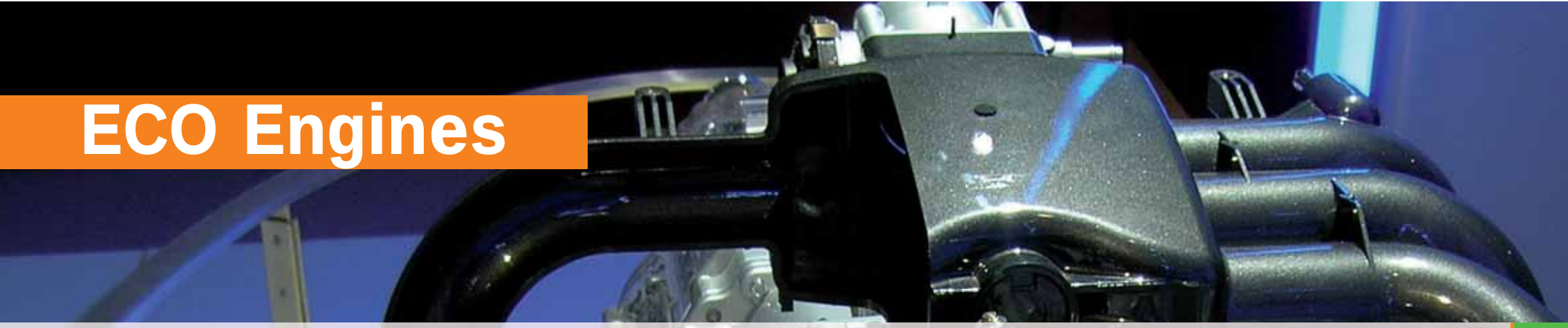
Coordination and Support Action

2008 - 2012

TNO Budget/Total EC Budget: EUR 1.105.300 / 2.590.000

www.civitas-initiative.org

ECO Engines



Research on energy conversion in has shown the great potential of advanced combustion modes like CAI, HCCI or CCS in terms of increased efficiency and reduced emissions. Internal combustion engine research in Europe is presently regarded as leading worldwide, especially in the field of compression ignition engines. However, this research had been characterised by a large variety of projects with little interaction between them. The Network of Excellence project 'ECO Engines' was a response to this.

The objective of the ECO Engines proposal for a Network of Excellence was to set up a Virtual Research Centre (VRC) on advanced engine combustion modes for road transport, with special emphasis on the use of alternative and renewable fuels, and to establish this VRC as a world reference in the domain. This VRC structures and integrates the excellence of European research on all aspects of new generations of high-efficiency, low-CO_2, low-noise and near-zero emission engine combustion processes and other emerging highly promising techniques. The specific focus targets experimental techniques (including optical diagnostics and ultra low-emission measurement), combustion simulation, testing and evaluation of fuel/engine couples, plus engine related aspects and combustion control.

The results have generated include a central database with a state-of-the-art survey of knowledge in relevant research fields, an ECO Engines website, a set of best practices (standard methodologies and procedures) and the definition of new common high-potential research. The results of the cooperation have been disseminated in conferences and publications. The set of best practices has generated guidelines for advanced diagnostics, complex numerical modelling and the assessment of fuel/engine combinations as well as training material for young and experienced engineers and academics in the field of advanced diesel combustion.

TNO was co-leader (together with Volkswagen) of the work package on standards for fuel/engine evaluation and a participant in the state-of-the-art survey and database of fuel/engine efficiency and engine technology and control.

Network of Excellence

2004 - 2006

TNO Budget/Total EC Budget: EUR 155.500 / 2.000.000

http://project.ifp.fr/eco-engines

Harmonoise

There is a need for harmonised methods in Europe to compute environmental noise impact from road and rail traffic. The differences in computation methods (source descriptions, propagation parameters and influences) in various EU countries make comparison of results impossible. Furthermore, complex propagation conditions (like multiple reflections in built up areas or meteorological influences on sound propagation) cannot be handled accurately by the current models.

The Harmonoise project was intended to develop new methods for noise impact computation to enable harmonisation based on reliable physical principles and validated against field data. Methods were developed to accurately and physically describe and assess noise level output and the directivity of sources of road and rail traffic. The format for collecting and storing databases for source dependent and location dependent data was defined and reference and engineering methods developed for sound propagation that take account of all relevant propagation parameters. A method was also devised to collect empirical data under well-defined conditions over a long period of time and to validate the models against these data. Finally, all these objectives had to be integrated into a single system of methods for use anywhere in the EU.

The goals of the project were achieved and the results used in the IMAGINE project for further implementation. The models offer new advanced tools for noise impact computations. TNO has used the reference propagation model already for various research projects such as prediction of the far field effect of noise barrier tops on noise barrier efficiency.

In Harmonoise TNO was work package leader for the development of a reference sound propagation model for road and rail traffic noise based on numerical simulation methods. It serves as a validation standard for the engineering model. Furthermore, TNO participated in the development of source emission models for road and rail vehicles and led the combined validation of the reference and engineering models against field data.

Shared Cost RTD

2001 - 2004

TNO Budget/Total EC Budget: EUR 580.000 / 5.200.000

www.harmonoise.org

HI-CEPS

Competitive solutions which result in a real, tangible impact ensure a globally competitive European automotive industry that retains or boosts its role as a principal economic driver for Europe. And which respond to social needs – lower consumption and regulated emission reduction – and customer needs – enhanced performance, improved driveability, high thermal comfort and affordability. Three hybrid solutions and corresponding after-treatment systems were investigated.

The objectives were to reduce fuel consumption by more than thirty-five per cent compared with today's best-of-class conventional vehicle and by more than ten per cent against the current hybrid equivalent in NEDC, including air conditioning requirements. As for noxious emissions, the goal was to go below a quarter of the EURO4 levels for a range more than ten kilometres with negligible impact on air quality, and ultimately to achieve zero emissions. Further aims were to keep costs low, use innovative auxiliary components to optimise overall electric and thermal energy flow at vehicle level and develop a dedicated petrol, diesel and natural gas internal combustion engine for full hybrid application.

The project resulted in a control model and strategy for the hybrid powertrain with a natural gas internal combustion engine and electrically heated after-treatment system. The powertrain was validated on a test bench and a report produced on the crash safety aspects of the proposed vehicles as well as a cost analysis of vehicle integration. A validated methodology and approach for integrated powertrain control to generate affordable, low-emission hybrid powertrains, enhanced performance, good driveability and high comfort will not only reduce CO_2 and hazardous emissions, improving local air quality in the process, but also contribute global warming solutions.

TNO developed the integrated control of the hybrid powertrain (natural gas engine) and the electrically supplied exhaust gas after-treatment system for one of the vehicle demonstrators, and was responsible for the safety analysis of the three vehicles and a cost analysis framework for vehicle integration.

Integrated Project

2005 - 2010

TNO Budget/Total EC Budget: EUR 879.000 / 18.776.900

www.hi-ceps.eu

MEGAPOLI

In the emergence of increasing numbers of megacities, high pollution levels and the impact of emissions from these urban agglomerations on downwind regions and on regional and global climate are real concerns.

The new European project MEGAPOLI (Megacities: Emissions, urban, regional and Global Atmospheric POLlution and climate effects, and Integrated tools for assessment and mitigation), due to start in 2008, brings together leading European research groups as well as state-of-the-art scientific tools and key players from countries outside Europe. MEGAPOLI will bridge the spatial and temporal scales that connect local emissions, air quality and weather with global atmospheric chemistry and climate. The objectives are to assess the impact of megacities and large air-pollution hot-spots on local, regional and global air quality, to quantify feedback in terms of megacity air quality, local and regional climate as well as global climate change, and to develop improved integrated tools for prediction of air pollution in megacities.

A methodology to estimate the impacts of different scenarios of megacity development on human health and climate change will be one of the project's results. Improved knowledge on the importance of multiscale transport processes from outside Europe and its importance on air quality and influence on environmental quality will be vital to policy and strategy decisions on air pollution and urban development in Europe. The results will be disseminated to authorities, the policy community, researchers and the other stakeholders in the corresponding megacities.

TNO is leading the work package on emissions, compiling accurate global anthropogenic emission inventories, which are a prerequisite for modelling megacity air quality, like EDGAR (TNO and MPI are co-developers), the EU-IP RETRO database (TNO) and the global carbonaceous aerosol inventory, enhancing the resolution of the current gridded data and nesting the case study cities accurately in the global data base. Several sensitivity runs describing future megacity development will be carried out in MEGAPOLI, with TNO responsible for processing the emissions.

Collaborative Project

2008 - 2011

TNO Budget/Total EC Budget: EUR 184.500 / 3.398.900

www.tno.nl/eu-projects

Intelligent vehicles

Jan van Dijke

Riné Pelders

An intelligent vehicle basically incorporates a combination of sensors, communication systems and controllers designed to enhance safety and performance for the driver and/or the vehicles. However, the concept and definition of intelligence has widened to incorporate elements like vehicle-to-vehicle and vehicle-to-infrastructure communication. This demands a more integral approach to driving in which technology, the environment and human factors are all key components of the mobility mix. Not only are the vehicle and the driver being made safer, better informed and more comfortable by technology but they are rapidly becoming more and more connected to the driving environment as a central component of it. This is clearly evident in various initiatives that are generating shorter-term technology innovations and in longer-term policy initiatives that are heading to a point at which technology, policy and legislation will ultimately converge.

It is at this interface where technology, policy and legislation meet that TNO has played, and will continue to play, a significant role. There is a need for knowledge to be exchanged and shared among stakeholders in relevant areas. These areas include intelligent transport systems (ITS), the large-scale introduction of systems based on cooperative vehicles and roadside infrastructure as well as the real-life operation of intelligent vehicles in ordinary traffic. The centrality of TNO's role in the international development of intelligent vehicles and systems is underlined by its strategic position, providing the link between R&D on the one hand and application on the other. By participating in international networks and European-wide projects and programmes, TNO both benefits from and contributes to research and development across the whole spectrum of intelligent vehicles and cooperative systems. The payoff is that results can be tangibly implemented and, in turn, mobility goals achieved.

CityMobil

More than a hundred cities throughout the world are expected to achieve megalopolis status of over ten million inhabitants during the next fifty years or so. Furthermore, many smaller cities are likely to face bleak prospects unless they are connected to major urban centres. These cities of tomorrow will need integrated traffic solutions that are able to provide the required mobility in an efficient, safe and economically viable manner. It is inevitable that automation, in all its possible forms from providing information at one end of the spectrum to fully autonomous driving at the other, will play a major role.

The objective of the CityMobil project is to achieve more effective organisation of urban transport, resulting in a more rational use of motorised traffic with less congestion and pollution, safer driving, a higher quality of living and enhanced integration with spatial development. This objective is brought closer by developing integrated traffic solutions: advanced concepts for innovative autonomous and automated road vehicles for passengers and goods, embedded in an advanced spatial setting.

As a result of the CityMobil project, large-scale implementations of automated transport systems will feature in three European urban centres, with a number of smaller short-term events boosting the knowledge of all the stakeholders about the possibilities and prospects of automated transport. The research and development programme will identify and address a number of barriers of various natures (technological, administrative, legal, integration in existing infrastructures).

TNO is acting as overall project coordinator for the CityMobil project that runs through till 2011. In addition, TNO is involved in a number of the research activities, more particularly in the fields of human factors, scenario development, sustainability and safety/certification.

Integrated Project

2006 - 2011

TNO Budget/Total EC Budget: EUR 1.656.000 / 11.000.000

www.citymobil-project.eu

CVIS

With information and communication technology increasingly, and exponentially, present in both vehicles and roadside equipment, the potential of using these different systems cooperatively to boost the efficiency and safety of road traffic is an issue that is gaining more and more prominence.

CVIS (Cooperative Vehicle-Infrastructure Systems) is a project that is designed to achieve a number of high-level objectives. These are to create a solution that will allow vehicles and infrastructure to communicate with each other, to define and validate an architecture and system concept for a number of cooperative applications as well as develop common core components, and to develop an open and interoperable concept for cooperative systems.

To date the validation plans for the project and auxiliary projects (technologies and applications) have been finished. They contain the validation of the technical items and non-technical elements (openness and interoperability). Furthermore, a study of user acceptance of the services has been carried out, containing scenarios written to define user needs and requirements. As part of this a small driving simulator experiment was performed. As the capabilities of cooperative road systems becomes increasingly important for stakeholders like OEMs, road users, the road authorities and industry, the CVIS project will prove a valuable asset to them by revealing the feasibility of a comprehensive wireless communicating network between cars and infrastructure to ensure efficiency and safety of road transport.

TNO will be responsible for validation of the systems, ensuring that the system has been built correctly and whether that particular system has also been built with user needs in mind. Furthermore, TNO is also responsible for deployment enablers and is participating in the Dutch and Belgian test sites.

Integrated Project

2006 - 2010

TNO Budget/Total EC Budget: EUR 1.200.000 / 40.000.000

www.cvisproject.org

CyberCars-2

A vision of the short-term future is one of Cybernetic Transport Systems (CTS) based on fully automated urban vehicles (the Cybercars) on new dedicated infrastructures. Currently, however, CTS can only operate in low-demand environments where little vehicle interaction is anticipated. If these systems are to be able to cope with high demand, more cooperation among vehicles is needed.

This project has been addressing this need, employing vehicle-vehicle and vehicle-infrastructure communication, investigating especially cooperation among vehicles running at close range (platooning) and at intersections (crossing). The project's aim has been to develop, implement and evaluate communication-based management systems for Cybernetic Transport Systems and to demonstrate how these systems contribute to cooperative vehicle behaviour for fully automated vehicles and for dual-mode vehicles.

The project has resulted in four Cybercars (INRIA, TNO, IAI and CRF) that are capable of cooperative behaviour. This is being supplemented by a safety evaluation methodology. Further important results of the project will be a road traffic management system, the upper control layer as it were, and supporting tools such as dynamic vehicle and control models. The results, especially the automated cars with vehicle-vehicle communication, provide a "look into the future". Lessons learned will be applied for shorter-term developments in the field of ADA (Advanced Driver Assistance), especially Cooperative Adaptive Cruise Control (C-ACC), the successor to ACC. The accumulated knowledge and experience regarding vehicle automation can be usefully applied for test-track automation (the pre-production automated testing of normal road vehicles).

TNO's contribution is a Dual Mode Vehicle, a Smart capable autonomous driving, to facilitate cooperative behaviour among vehicles from other partners, with a special focus on intersection behaviour. Furthermore, TNO has led the work package on the design of a road traffic management system. Finally, TNO has contributed strongly to the evaluation of Cybercar systems with respect to safety issues through failure mode effects and criticality analyses.

Specific Targeted Research Projects

2006 - 2008

TNO Budget/Total EC Budget: EUR 627.000 / 4.200.000

www.c.inria.fr:9098/cybercars2

EuroFOT

The intelligent car initiative has identified road safety, energy efficiency and traffic congestion as the main challenges currently being faced by European transportation. While effective intelligent vehicle technologies are widely known to enhance traffic safety and efficiency and studies have also demonstrated that such enhancements are valued when acceptable, current knowledge about their real-life operation in ordinary traffic is limited.

The goal of the EuroFOT project is to identify and coordinate in-the-field testing of new intelligent vehicle systems that could improve the quality of road traffic in Europe and to generate early publicity for the technologies. A test plan will identify proper driving scenarios, maximum safety potential factors and expected results. This will be followed by customer recruitment and training, data logger installation, data collection under normal driving conditions and analysis of objective and subjective data to describe driver behaviour and adaptation, vehicle dynamics and acceptance of intelligent vehicle systems.

Assessing the impact of intelligent vehicle systems in real traffic will provide indications for the deployment of ICT technologies for a safer, cleaner and more efficient transport system in Europe: performance and capability characteristics of several systems, analysis of driver behaviour and user acceptance as well as a detailed understanding of the impact on safety, efficiency and environment based on data in real traffic. Awareness of the potential of intelligent vehicle systems will be heightened and social-economic acceptance created. The results will be transferable to general European and global conditions.

TNO is leading the ‘Methodology and Experimental procedures’ work package and taking a leading role in specifying driving performance parameters, environmental indicators and traffic efficiency. TNO is task leader for the impact assessment work package, including scaling up FOT results to various penetration rates using the ITS Modeller, and will contribute to the user acceptance and user-related aspect evaluation work package by analysing the impact of selected systems on driver behaviour and workload.

Integrated Project

2008 - 2011

TNO Budget/Total EC Budget: EUR 977.600 / 22.100.000

www.eurofot-ip.eu

iCars

In the deployment of transport ICT technologies (or ITS – 'Intelligent Transport Systems') there is a need to exchange knowledge and experience on these technologies among a wide variety of stakeholders across a number of specific topics such as ITS development and public procurement, good practices for the dissemination of information and awareness among authorities, businesses and end-users, ITS impact assessment methods and evaluations, and the potential positive effect on energy efficiency in road transport and the development of a road map for the introduction of these technologies.

The iCars network will contribute to answering these issues in line with the general goal of the ICTPSP, which is to stimulate innovation and competitiveness through the wider uptake and best use of ITS by citizens, governments and business. The aim is to exchange good practices and develop catalogues of methods for using the latest ITS procurement developments, dissemination and awareness of ITS developments, to realise impact assessment and arrive at a roadmap for energy efficiency. This should promote the acceptance and use of ITS developments to reduce the number of deaths on the road and the environmental burden of road transport.

The network will contribute to these objectives by organising events with a broad spectrum of experts on each of the areas mentioned above, also addressing aspects such as obstacles to market acceptance and the identification of strategies to overcome these obstacles and generating roadmaps to get these technologies to market. Material will be made available through an iCars network website and via the best practices website of the European Commission. A report will also be drawn up containing the conclusions of the network events.

TNO will contribute to the thematic group on awareness activities based on its experience in the following networks: EARPA, ERTICO, ECTRI, EARTO, EIRMA and NETHER.

Thematic Network

2008 - 2010

TNO Budget/Total EC Budget: EUR 24.000 / 334.000

www.icarsnetwork.eu

PReVENT

To halve the number of road accidents by 2010, to boost the half the competitiveness of the European automotive industry, to create a European scientific knowledge community on road transport safety and to bring about a congregation and cooperation of European and national organisations and their road transport safety initiatives. These are all goals to which the integrated project PReVENT has contributed.

PReVENT envisions the early availability of advanced, next generation preventive and active safety applications and enabling technologies and an accelerated deployment on European roads. The targets included the development, demonstration, testing and evaluation of preventive safety applications using advanced sensor, communication and positioning technologies integrated into on-board systems for driver assistance as well as the facilitation of cooperation among stakeholders in order to encourage the earliest possible implementation of preventive/active safety systems in Europe.

PReVENT enabled the European industry to further strengthen this position by introducing leading edge technologies while helping to reduce road accidents. The impact of the technological results can be found in the areas of safe speed & safe following, lateral support & driver monitoring, intersection safety, vulnerable road users & collision mitigation as well as in cross-functional aspects like concepts for advanced sensors & sensor data fusion and safety-enhanced digital maps for ADAS applications. The impact assessment covered prototype development, concept demonstration, an evaluation framework and the development of technical solutions for low-cost enhanced vehicle 'intelligence' through integrating components available in today's passenger cars and preparing this type of application for short-term market implementation.

TNO contributed in different roles to the sub-projects WILLWARN, SASPENCE and PReVALL. In WILLWARN, for example, TNO estimated the traffic effects using the ITS Modeller. TNO modelled the communication, driver and message management aspects of the WILLWARN system and developed scenarios which differed in the hazard conditions addressed by WILLWARN as well as traffic intensity and road type.

Integrated Project

2004 - 2008

TNO Budget/Total EC Budget: EUR 1.528.000 / 29.800.000

www.prevent-ip.org

SAFESPOT

The escalating cost of growing mobility in terms of traffic congestion and (near) fatalities has seen a lot of research into the development of driver assistance systems based on autonomous sensor technologies able to perceive the traffic situation surrounding the vehicle and warn the driver appropriately. The scenario in which vehicles and infrastructure cooperate to perceive potentially dangerous situations is limited only by the radio communication range.

The objective is to understand how intelligent vehicles and intelligent roads can cooperate to produce a breakthrough for road safety. The key aspect of the project is to expand the time horizon for acquiring safety information for driving as well as to improve the precision, reliability and quality of driver information, and to introduce new information sources. This can be achieved by improving the range, quality and reliability of the safety-related information available to intelligent vehicles through extended cooperative awareness in a real-time reconstruction of the driving context and environment. Drivers can also be assisted to take appropriate preventive manoeuvres and vehicle control intervention can be optimised for critical situations.

A prototype-validated safety system, the Safety Margin Assistant, based on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, detects potentially dangerous situations in advance, extending driver awareness of the surrounding environment in space and time. The added value of SAFESPOT is to find the optimum combination of information from both vehicles and the infrastructure. The R&D focus is initially on cooperative solutions for critical situations, or black spots, whose severity is quantified by statistical data.

TNO is involved in the development of a unified world model and the safety applications that use this Local Dynamic Map. TNO is coordinating the verification and validation of all the applications as well as the investigation of the relevant business and legal aspects for the large-scale introduction of systems based on cooperative vehicles and road side infrastructure.

Integrated project

2006 - 2010

TNO Budget/Total EC Budget: EUR 1.400.000 / 20.500.000

www.safespot-eu.org

Partners in projects

4sight, A.D.A.C., A.D.C., ACEA, ADAS management Consulting, Advanced Transport Systems Limited, AEA Technology Rail, Agenzia per i Trasporti Autoferrotramviari e la Mobilità del Comune di Roma, ALCOR, ALTAIR, ALTEA, Amadeus SAS, AMANOVA, ANAS S.P.A., APPLUS+, ARIANET Consulting, Aristotle University of Thessaloniki, ARMINES, ARPAT, Arttic, Audi, Autobahn Direktion Südbayern, Autostrada Brescia Verona Vicenza Padova, AVL List GmbH, Azienda Sanitaria Locale Caserta 1, AZT, Babcock & Brown, BARC, BASt, Bertrandt, BIVV, Blaupunkt, BMW, Bosch, Brunel University, Budapest University of Technology and Economics, Budapesti Muszaki es Gazdasagtudomanyi Egyetem, Bundesanstalt für Strassenwesen, Bustioness region Goteborg, C.R.F. 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DLR, DGMR, DGT, DIBE, Dipartimento di Idraulica Trasporti e Strade Università di Roma La Sapienza, Dipartimento VII Politiche della Mobilità, DLR, DMI Danish Meteorological Institute, DMR, Dresden University of Technology, DRSC, DTF, DTU, Dutch Ministry of Transport, EC-JRC, Ecocat Oy, EICAS Automatione, EICT, Eneftech Innovation, ENQ, EPFL, Ergonomics & Safety Ltd, ERT, ERTICO, Aalborg, University, ESI Group, ETH Zurich – Eidgenössische Technische Hochschule, ETRA Investigación y Desarollo, Eurisco, European Bulls, European Center for Information and Communication Technologies GmbH, European natural gas vehicle association, Excellent, Factum, FAURECIA, Federal Highway Research Institute, Fédération Internationale de L'Automobile, FEMA, FEV Motorentechnik, FhG, FHI, FIAT, Flanders Ministry of Transport, FMI Finnish Meteorological Institute, Ford Forschungszentrum Aachen, FORGIS, FORTH Foundation for Research and Technology, FORWISS, Fraunhofer, FTSS, Fundación Comunidad Valenciana Región Europa, Fundacion para la Investigacion y Desarrollo en Automocion, Gaz de France, GDV, GEA J-M Vallotton et T. Chanard SA, Generalitat Valenciana, Gesameverband der Deutschen Versicherungawirtschaft e.V., Getrag Ford Transmissions, Goteborg Energi, Gottfried Wilhem Leibniz Universität Hannover, Griffith University, Hasselt University, Helsinki University of Technology, Hitachi Europe, IBEO Automobile Sensor GmbH, IBSR, ICCS, ICTP International Centre for Theoretical Physics, IDIADA Automotive Technology SA, IDOM Ingeniería y Consultoría, IES, IFADO, IFAK, IFT, IfT Institute of Tropospheric Research, IFTR - Polish Academy of Sciences, IMC, Imita, Implementation Coordination Organisation s.c.r.l., INFOBLU SPA, Ingegneria dei Trasporti, INRETS, INRIA, INSIA UPM - Universidad Politectica de Madrid, Institut Français du Pétrole, Institut für Kraftfahrwesen der RWTH Aachen, Institut für Solare Energieversorgungstechnick e.V, Institute for Transport Economics, Institute for Transport Studies, Institute of Communication and Computer Systems, Institute of Shipping Economics and Logistics, Institute of Studies for the Integration of Systems, Instituto de Automática Industrial, Instituto di Studi per l'Integrazione dei Sistemi, Intelligent Control System Laboratory, Intempora, Interuniversitair Micro-Electronica Centrum vzw, IPTS, Irion Management Consulting GmbH, ISCTE, ISI, ISIS, Ispra, IST, Istituto Superiore Mario Boella, Italian Inter-University National Consortium for Telecommunications, ITS Leeds, IVG Universität Duisburg-Essen, IWW, IZVW, JCI, JRC-IHCP, K.U. Leuven, Kapsch Trafficcom AB, KCL King's College London, KfV, KILDE, KITE, KLPD, KTI (Közlekedestudomanyi Intezet KHT), KTL, LAB (PSA+Citroen+Renault), Laboratoire Central des Ponts et Chaussees, Lacroix Trafic, LAMP, LCPC-INRETS, Lewicki Microelectronic, Lille metropole, Lindholmen, LIU, LMU - University of Munich, LogicaCMG Nederland B.V., LogIT, Loughborough University, LSCE, LTE, Ludwig Maximilians Universität, Lunds tekniska högskola, M+P, Magna Steyr, Magneti Marelli Sistemi Elettronici S.P.A., Malaguti Spa, MAN, MetO UK MetOffice, MIRA Ltd., MIZAR Automazione S.P.A., MOOG FCS, MOTOROLA, Movea Trafikkonsult AB, MPIC Max Planck Institute for Chemistry, National Technical University of Athens, NAVIGON, Navteq, NEA, NEC Europe, NERSC Nansen Environmental and Remote Sensing Center, Newrail, Niedersächsisches Ministerium für Wirtschaft, Arbeit und Verkehr, NILU Norwegian Institute for Air Research, Norwegian Public Road Administration NPRA, Norwegian University of Life Sciences, NTUA, OCTAV Ltd, OPEL, Oracle Belgium N.V., Orange France, Paioli Meccanica, Pasteur, PBS - Projektgruppe für betriebswirtschaftliche Studien, PDB, Peek Traffic B.V., Perkins Engines, Peugeot Citroen Automobiles, Philips, PIAGGIO & C S.P.A., POLIS, Politechnika Warszawska, Politecnico di Milano, Politecnico di Torino, Promotion of Operational Links with Integrated Services aisbl, Provincie Noord-Brabant, PSA, PSI Paul Scherrer Institute, Planung Transport Verkehr AG, Q-FREE ASA, Rail4Chem, RAPP Trans AG, Reaction Engineering Solutions, Regienov, Renault, Renesas Technology Europe GmbH, Rheinisch-Westfälische Technische Hogschule Aachen, Ricardo, Rijksuniversiteit Groningen, Road and Bridge Research Institute, Robosoft, Robotiker, Rups Consultants, Saft, SAGEM, SAP, Scania CV AB, Schmitz Cargobull, SEAT, Selin Sistemi, SEM AB, ServtTrans Invest, SGSD, Shanghai Jiao Tong University, Siemens, Signalbau Huber, SIPSiVi, SKODA, SNCF, Societe pour le Developpement de l'Innovation dans les Transports, Socrates Basbas, Soptim, SP, Stratum OÜ, SWOV, TCI-Röhling, Technical Research Centre of Finland, Technical University of Graz, Technion (IIT) Research & Development Foundation, Technion-Israel Institute of Technology, Technische Universität Chemnitz, Technische Universität Graz, Technische Universität München, Technolution B.V., Tele Atlas N.V., Telefonica Investigacion y Desarrollo sa Unipersonal, TFA-UNPD, The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology, Thomas Miller & co. Limited, TK- P, TOI, Total, Toyota, Transpetrol, Transport & Mobility Leuven, Transport Research Centre of Czech Republic, Transport Research Lab, Transportation Research Group, Transver, TRC, TREDIT (Transeuropean Consultants for Transport, Development and Information Technology), TRL, TRT, TRW Limited trading as CONEKT, TVS Motor Company Ltd, U. 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