# 1 Publishable summary

## 1.1 Project objectives

The main objectives in ASSET-Road focus on the development, testing and implementation of a holistic approach to improve safety and efficiency in road transport by integrating four different areas or entities: Driver and operator, vehicle and traffic, infrastructure and environment and regulation and control.

Hereby, road safety is the key element. The highest priority is put on accident prevention by improved driver awareness and early warning procedures in case of incidents and hazards. Cleaner traffic will be a by-product of enhanced safety and more fluent traffic-flow. Four major different innovation areas are approached:

1. Implementation of a holistic approach to system theory of safety
2. Enhancement of the integration/co-operation between the relevant parties in traffic safety and analysis of the interdependencies
3. Emphasis on sensor data fusion method and a new sensor combination (using weigh-in-motion (WIM), monitoring vehicle position in the lane, vehicle tyre/wheel condition and using video sensors for tracking)
4. Implementation of a new management of Many-To-Many (M2M) communication.

## 1.2 Work performed

**WP0 Project management and coordination**

Project Management has covered coordination and management of work performance, timing and meetings, financial issues, quality control and internal reporting as well as to reporting to the European Commission.

**WP1 Holistic Safety & Requirements**

This work package focuses on improving road safety and road traffic by pushing different transportation stakeholders to interact between each other and integrating modern communication and sensing technologies. Development targets were to be indentified in order to enable interaction between the proposed quadrangle entities (road-driver-vehicle-regulations). The main issue is to improve and bring the existing single elements of safety theories in practice, integrate them in a holistic approach and fill in the technical holes in traffic and transportation safety area. Its outcome was a first guideline for the ASSET-Road work packages to create synergy, further development traffic safety systems and to keep the whole system harmonised.

A new and unique ASSET-Road safety theory, a dialectic quadro-pole and integrated system architecture was developed and described how its architecture is compatible with the European ITS Framework Architecture. Based on state of the art analysis for road safety theories recommendations were given on how to achieve better road safety by a recommended methodology (A program and an administrative set up of a road safety agency concept) and road safety performance indicators. An integrated architecture for the test sites was presented and case studies for ASSET-Road countries Hungary and Finland reported.

**WP2 Development of Key Technologies**

Sensor data fusion technology and communication and monitoring technology (hardware and software) were dealt with in this work package. After development and implementation into the project test sites under WP6 first tests showed that further adaptations were necessary, mostly due to the integration to WP4 and WP5 applications. Today the first prototypes of weigh-in-motion (WIM) sensors with integrated RFID for fully automatic overload enforcement, subsurface thermal imaging detecting defective brakes, tyres and bearings, road condition monitoring, seat belt compliance detection, GNSS, driver behaviour analysis, tracking & tracing system using video surveillance and regulation knowledge base technology including a multi-agent system passing information to drivers are available.

**WP3 Innovative Solution: Improved Driver Behaviour Compliance**

Driver compliance with road regulations and safe driving practices was analysed. Starting from the results of a survey conducted in several EU countries, three main activities were carried out: 1) the Smart In-Vehicle Information System (LISA) was designed, specified and developed to a prototype application, 2) the most relevant scenarios to test the prototype were implemented to enable driving simulator tests and 3) the integration between prototype software and Virtual Agents software was performed. LISA was tested and feedback from system users and HMI expert finally led to prototype modifications.

**WP4 Innovative Solution: Safe & Sustainable Infrastructure**

A concept of protection and life cycle optimisation of infrastructure to reduce damage to infrastructure was established. The full pavement damage model was programmed and integrated in a model representing the spatial repeatability in a vehicle fleet. Work on load flow modelling and road impacts was completed. Major progress was achieved concerning infrastructure durability and safety models, road and safety conditions maintenance and life cycle optimisation, and optimum operation and life cycle optimisation. A 3-dimensional model was developed for the prediction of the progression of damage. A wavelet approach has proved to be a more effective tool than any currently existing for the prediction of remaining pavement life. A Finite Element model was used to determine the sensitivity of pavements to different types of tyre. A “Bridge Friendliness Index” was developed to post-process Weigh-in-Motion data.

 

A framework for pavement damage evaluation through its life has been modularized and put on an internet platform as an international benchmark against which researchers, worldwide, can compare their models. Alternative strategies for bridge damage detection have been developed (i) using sensors attached to the bridge and (ii) “drive-by” damage detection, i.e. using sensors attached to vehicles driving over the bridge. Both strategies have shown to be effective but require further development. Additionally a low-cost pavement sensor was developed and tested as well as strategies for recycling pavements, including recycling-in-place approaches. Finally strategies and visions for road infrastructure optimisation and maintenance and possible future road pricing were developed.

**WP5 Innovative Solution: Kybernetic Transport/Traffic**

A TransportML middleware for intelligent interactive services was developed and tested. A software tool was developed to define the characteristics of geographical areas as well as techniques to restrict access or exit to a given type of vehicles, so-called Geofencing, to define appropriate routes for a certain type of vehicles, thus ensuring that each concerned vehicle follows the assigned route from origin to destination (e.g. snow clearance vehicles, emergency services etc.) to reduce travel times and increase efficiency. An in-vehicle embedded software was implemented and tested, its main objective being the extraction of information, such as ABS triggering, from the CAN bus of the vehicle and the exchange of that information with other nearby vehicles via V2I/V2V communication.

Different traffic models were investigated and new innovative methods and algorithms developed and recommended. The classic Transport force model was analyzed and a new axle weight-based Transport force model was developed. Furthermore, a $CO^2$ emission of traffic was analysed and evaluated.

The analysis of data on heavy traffic and its impacts on the test site in Rosenheim showed interesting effects concerning traffic patterns and driver behaviours (violations). A cost-benefit analysis (CBA) was elaborated comparing conventional and ASSET-Road technology based control approaches, which achieved significant improvements concerning control rate, control efficiency and reduction of effort.

Data security was analysed and most suitable technologies recommended for integration into software and platforms deployed in different test sites.

**WP6 Test Sites Development & Operation**

The success of the ASSET-Road project depends finally on the design, construction, functional testing and performance of operational test sites which serve the purpose of demonstrating the technological developments and innovations for improving. A cluster of international test sites distributed throughout Europe was established, the “Safety station” in Rosenheim, Germany, the “Portable safety applications” in Finland ,the integration of the “Research and test bed modules” in Graz, Austria, and the French test site “GMSS based safety applications” in Belfort. On all sites testing, improvements

 

and operation continued and culminated in the Final Workshop, during which the project results were presented to the interested public.

An additional public deliverable DEL6.4 called "*Evaluation results, recommendations and exploitation*", easily readable and illustrated with pictures, was compiled. It is meant to be the summary of the different deliverables produced in the course of the project, explaining the work done with a particular emphasis on all those aspects approached in the non-public deliverables, highlighting the project results and their present, potential or planned future exploitation.

**WP7 International Cooperation, Dissemination and Exploitation**

For an efficient information dissemination of the ASSET-Road results it is vital to establish contacts with stakeholders, to organise meetings and to liaise with related projects and initiatives, e.g. with ongoing EC activities. User group meeting were held, scientific and other publications, interviews and TV productions as well as ASSET-Road conferences in Tanzania, India and Hungary were organized for road authorities, industry and other stakeholders to inform about and disseminate the project results.

At the end of the project an ASSET-Road Final Workshop was set up. Near the German test site on the premises of the local motorway surveillance centre invited representatives of authorities, police, industry as well as other interested parties had the unique opportunity to visit all three test sites of the project on one occasion and gain further information.

## 1.3 Final results

A practical, holistic system approach to sustainable road transport focusing on traffic safety was developed leading to an overall safety theory to manage complex cybernetic interactions. The analysis and better understanding of the different processes and chains of interdependencies allowed identifying critical parameters influencing safety. Project results will have positive impacts on safety, security and environment, too. The developed integrated technical solutions including electronics hardware and software of sensor systems and wireless communication/power supply technologies will provide ample opportunities and enhance the possibilities of European industries to further develop their competence in these fields. For more information please visit the project website under: **www.project-asset.com**

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