Towards a Common Research Strategic Roadmap for the Transportation Sector in Europe and beyond

Dr. Evangelos BEKIARIS
CERTH / HIT, 52th Egialias str.
Athens, 15125, Attica, Greece

Matina LOUKEA
CERTH / HIT, 52th Egialias str.
Athens, 15125, Attica, GREECE

Steve PHILLIPS,
FEHRL, Bld de la Woluwe 42
Brussels, 1200, Belgium

and

Wolfgang STEINICKE
Group, Hubertusallee 29
Berlin, 14193, GERMANY

ABSTRACT

DETRA (Developing a European Transport Research Alliance) is a 7th Framework project, whose concept derived from the so-called Lyon Declaration and concerns the deepening of the European Research Area objectives in transport in order to address the Grand Challenges. Key priorities of this Alliance is to examine the strengths, weaknesses, opportunities and threats (SWOT) in the domain and develop common understanding and approaches to reducing fragmentation and overcoming barriers. The DETRA project aimed to meet and exceed the requirements and objectives of the call for an Analysis of the state of ERA development within the transport domain and to develop recommendations for the EC, member states and other stakeholders as well as for the DETRA partner organizations themselves. In this study, particular emphasis is given to the part of DETRA concerning the development of a single trans-European research program, which can be used as a compass for the future research activities of the whole transportation area.

Keywords: Transportation Area, European Research Area, Research Priorities, Transport Research Database, Pan-European Research Program.

1. INTRODUCTION

Transport is a key area, affecting most of the Great Challenges of Europe, according to the Lisbon Treaty. Although substantial progress in improving the transport sector has been made across Europe during the last decade, it is clear that different countries are improving at different rates, gains in some countries are becoming increasingly difficult to obtain, some sectors of road users are seeing a decrease in the development and the demographic and socio-economic influences on road user behavior will drastically influence transport in the coming years. The continuing objective of further evolution in the EU transportation system should be properly supported by ambitious, cost-effective and targeted research activities. Increasing effectiveness and efficiency of research in the transport area is a mission having a direct impact on the quality of life in Europe.

At a time when Europe faces economic constraints, resources devoted to research must be spent wisely. In order to help this process it is necessary to describe and determine priorities. If these priorities are widely known and disseminated it helps both those who provide the research and those who fund it. Research organizations can consider how to address the topics and define where alliances of complementary skills need to be made, what assets best need to be developed and what techniques to be applied. Research funding organizations should consider budgets, determine where contingencies arise and set the appropriate frameworks for implementation, including regulation and legislation that might be needed to maximize the benefits.

In this context, an EC co-funded project called DETRA, was initiated, in order to contribute to the government of the research in the transportation area. The aim of the DETRA project was to analyze and then guide ERA development within the transport domain. DETRA's concept derived from the Lyon Declaration, which was signed in 2008. Lyon Declaration's signatories, i.e. ECTRI, FERSI, FEHRL, EURNEX, HUMANIST, ISN and NEARCTIS organizations committed themselves to work together on the deepening of the European Research Area in the transport domain. From this commitment grew the objective to create a European Transport Research Alliance (ETRA) that would strengthen research in the transport domain. Key priorities of this Alliance are to examine the strengths, weaknesses, opportunities and threats (SWOT) in the domain and develop common understanding and approaches for reducing fragmentation of research and overcoming barriers of implementation.

The most important key priority of DETRA and of the organizations that collaborated in this project was to address the major challenges, as they were defined by the European Union. These challenges are related to all sectors of our society (e.g. public health, climate change, globalization etc.) and according to the perspective of DETRA and its members, in each of these challenges the transportation sector can contribute to its solution. Some examples of such a transportation effect in the major challenges of Europe are the following:

- to make transport infrastructure and transport systems more resilient to a changing climate as well as directly reducing the climate change impacts of transport;
- to reduce energy consumption in the transport system, increasing the security of supply to reduce transport system impacts on ground water supplies and consider transport and water in land-use planning;
- to raise the standards of public health by increasing access to health facilities (including developing countries), increasing the resilience of the transport system in pandemics and reducing traffic accidents fatalities and injuries;
- to shape and maintain a transport system that reflects the needs of the developing globalization and to help European transport system stakeholders to adapt accordingly;
- to increase the effectiveness of transport necessary for food production (including developing countries) and to improve/innovate in transport logistics to reduce food waste;
- to adapt transport and mobility systems to an aging population.

2. OPTIMISING RESEARCH PROGRAMMES AND IDENTIFYING PRIORITIES

Within the context of the DETRA project a significant emphasis has been placed on well-coordinated research programmes and priorities, including a jointly-programmed public research investment at European level involving common priorities, coordinated implementation and joint evaluation. This was the objective of the project's WP titled "Optimising research programmes and identifying priorities".

This goal has been initially pursued by a survey on the existing research programs and roadmaps developed in single European states, at the EC level, as well as internationally,, related to all areas and all modes of transport. The purpose of this process was to collect all the research priorities for each transport subarea that concern any existing gaps or emerging for any transport mode.

Finally, more than 40 such research priority recommendations and/or roadmaps had been analyzed, stemming from several types of organizations, such as technology platforms (e.g. ERTRAC, ERRAC, etc.), research institutes associations (e.g. FERSI, ECTRI, FEHRL, etc.), industrial associations (e.g. EUCAR, CLEPA, ACEM) and citizen representive organizations (e.g. POLIS, FIA, FEMA, etc.). Of course, special emphasis was given to the roadmaps and documents of the European Commission, as for example the "White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" and the "Europe 2020 Flagship Initiative Innovation Union".

The collection of the material, which was a continuous process throughout the duration of this project, had been followed by the classification and categorization of the information, that has been based upon an electronic template for the classification of each research document's information, according to the four (4) major categories of transport designated by the beginning of the DETRA project (Safety & Security, Congestions & Capacity, Environment & Energy, Globalization). In addition, this template also helped to the analysis of the key elements of the documents.

Research Priorities

Starting from these 4 key areas that constitute the backbone of the DETRA project, and according to the information collected by all the analysed documents, a list of research priorities had been emerged, containing 20 research areas and nearly 92 themes. This categorization of the transport research priorities concerns all the transport modes (road, rail, maritime and aeronautics) and reflects their research needs. Below, the research priorities of Safety & Security and Congestion & Capacity domains are being indicatively presented, while this kind of categorization has been also done for the other major areas.

I. SAFETY & SECURITY

- **Road Transport**
  - Passive Vehicle Safety
  - Active Vehicle Safety
  - Training
  - Simulation
  - Infrastructure Safety Measures
  - Cooperative Systems
  - Testing Platforms & FOTs
  - Vulnerable Road Users
  - Advanced road surface and bridge materials

- **Railway Safety**
  - Threat Analysis
  - Active & Passive Safety Systems
  - Training
  - Design of Infrastructure
  - Crisis Management Procedures
  - Terrorism

- **Maritime Safety**
  - Development of Prevention Strategies (Risk – Based Design)
  - Human Machine Interface
  - Development of Robust Ships and Reliable Equipment
  - Strategies, Methods & Procedures for Safeguarding Security
  - Development of Decision Support Systems

- **Aeronautics Safety**
  - Human Machine Interface
  - Threat Analysis / Risk Prevention
  - Active and Passive Vehicle Systems
  - Simulation
  - Mitigation Strategies
  - Training

- **Security**
  - Risk Management
  - Protective Measures
  - Mitigation Strategies
  - Resilient Infrastructures
  - Network Components Critically Computation
  - Supernetworks

II. CONGESTION & CAPACITY

- **Road Infrastructure**
  - Monitoring & Maintenance
  - V2I Communications
  - Dedicated Infrastructure
  - Electronic Tolling Systems

- **Traffic Management**
  - ITS
  - Advanced land and waterborne transport management systems
  - Active Traffic Management

- **Urban Planning**
  - Car free Zones/Areas and urban road pricing
  - Transit-oriented Development
  - Non-motorized Mobility (e.g. Pedestrians & Bicycles)
  - Traffic Calming Measures and Shared Space

- **Supply and Demand**
  - Dynamic Traffic Assignment Models
  - Fusion of Micro & Macro Traffic Simulation and Planning Models
  - Activity based Models

- **Multimodality**
  - Freight
  - Infrastructure
  - Interoperability
  - Single European Transport Area

- **Aeronautics**
  - Interoperability Principles
  - Development of New Management Systems
  - Single European Sky (SESAR)
  - Improvement of the Efficiency and capacity of airports
  - Simulation & Modelling
  - Novel Concepts of Automated Aircrafts

- **Rail**
  - Tracking including Sub-grade and Rail
  - Interoperability
  - Wheel/Rail Interface
  - Signalling and Control Systems - Line-side Equipment
  - Intelligent Mobility, e.g. Telematics (Galileo), Intermodality, Customer Information Systems, Web-based Information Systems

- **Maritime**
  - e-Maritime Initiative
  - Inland waterway transport

Transport Research Work Programmes and Roadmaps Database

The determination of Research Priorities has also provided the structure of the "Transport Research Work Programmes and Roadmaps Database" which was developed for the collection, sorting and analysis of the research programs and roadmaps.

The objective of this database was to provide a tool which would facilitate the detailed and clear presentation of all the relevant research documents. In this web-based tool (http://160.40.63.90/detra/), anyone has the opportunity to search for the documents that he/she is interested in, as well as to suggest further documents regarding research priorities and roadmaps in transport. This database is considered as being a living structure, which grew and developed until the end of the project. The content of this database, which was continuously updated, was collected through a detailed literature survey made by all DETRA partners, as well as by collecting research programmes that have been developed by the partners themselves.

The DETRA tool is a fully web-based application. A web-based solution was selected, as this one guarantees easy access, without the need of special software for the end-user. A combination of technologies has been used for the successful development of this tool. The technologies that have been used are the following:

- HTML, PHP 5 and CSS are the technologies used for the design of a dynamic web application.
- MySQL 5, which is a powerful open source database tool for the design and management of databases.
- NetBeans IDE early access for PHP, which is an open design application by which a fully functional and complete website can be created.
- APACHE HTTP Server 2.2, which is an open – source HTTP server for modern operating systems. It is a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards.

This tool had been developed in order to support the DETRA EU project and, as mentioned above, the main idea was the design and development of a tool which will be able to collect research programmes. It consists of three areas. These are i) Home ii) Insert and iii) Search areas.

Figure 1: Home page of "Transport Research Work Programmes and Roadmaps Database".

In more detail, the "Home" area contains the login form together with all the appropriate functionality of a login page, e.g. "Register", "Forgot your username", etc. The "Search" area is available to all visitors (registered or not). It provides a search engine which is able to present the stored information in many different ways according to the criteria selected by the user. On the other hand, only the registered users are able to insert information to the database of the tool. This can be done via the "Insert" area of the tool.

3. TOWARDS A MODULAR, PAN-EUROPEAN TRANSPORT RESEARCH PROGRAMME

The final outcome of this whole process, as mentioned above, has been the development of a single trans-European Transport Research Roadmap, containing all the relevant research priorities for each separate field of the transportation research area.

At the beginning of the process, a first draft of this document was prepared, which presented the main research priorities of the road transport area as far as the sectors of Safety & Security, Environment & Energy and Congestion & Capacity are concerned. For the presentation of this first draft, a workshop was held in the beginning of September 2011, in which nearly 20 stakeholders attended, along with the project partners. During this workshop, a fruitful brainstorming took place that led to valuable feedback.

After that, almost eight updated versions have been produced, until of the report, titled "Optimized pan-European Transport Research Work Programme". The iterative procedure followed included continuous dissemination and feedback from the DETRA partner stakeholders networks (FERSI, ECTRI, FEHRL, HUMANIST), as well as the implementation of three more workshops with both internal and external stakeholders.

Analysis of the Procedure
Every version of the "Optimized pan-European Transport Research Work programme, Roadmap and priorities" has been developed by the analysis of the various transport roadmaps and work programmes derived mainly from EU research and industry organisations.

Based upon the benchmarking database results, initially a set of commonalities and differences between the different transport research work programmes had been structured. These commonalities and differences have been obtained relying on the research priorities that have been presented above.

More specifically, during the analysis of each document, emphasis was given to the research needs and priorities described in it, which were related to the different domains and sub-domains of the transport area. All these research needs and priorities have been categorised according to the research priorities' list defined in the DETRA project and by this procedure a set of commonalities has come up concerning all the same or relevant needs and requirements that have been designated by the several different organizations as far as the fields of the whole transport domain is concerned.

			ERTRAC - "Strategic Research Agenda"	EUROPEAN COMMISSION- ""Towards a European Road Safety Area: Policy Orientations on Road Safety 2011-2020"	FERSI - ECTRI - "The Sustainable Safety Approach to Road Transport and Mobility"	EUCAR - "Challenges and Priorities for Automotive R&D"
SAFETY & SECURITY	**Road Safety**	***Active Safety***	Research on **Advanced Driver Assistance Systems** such as lane and distance keeping and warning for inappropriate speed.	Promotion of the use **of modern technology in order to increase road safety**.	Driver/ rider **monitoring technologies and tools, to prevent accidents** due to driver/rider inattention, excessive workload, fatigue etc.	Development of **driver assistance functions** to optimise overall potential, maximise comfort and safety for the driver.

Figure 2: Example of commonalities regarding the Active Safety theme

The Example of the Fields of Active and Passive Safety
Regarding the section of Road Safety, 35 documents from 20 key stakeholders have been taken under consideration and have been analysed in respect to their proposals for the future research requirements.

An indicative example of the results of the procedure described above, as well as a model of the basic structure of the "Optimised pan-European Transport Research Work programme" is the research priorities defined for the theme of Active Safety of the Road Safety section, which is presented below:

- **ROAD SAFETY**
  - **Research Priorities in Active Safety**

After the categorization and the extraction of commonalities from all the relevant documents regarding the Active Safety theme, the following research priorities have been emerged.

At first, the prioritization from the ERTRAC strategic agenda is being presented, which accepted and agreed by almost all the other organizations, either they are ERTRAC members or not.

- Safe integration of nomadic devices into the driving task and interfacing them to the CAN;
- Further research on ADAS, such as lane and distance keeping, warning for inappropriate speed, longitudinal and lateral distance sensing, collision avoidance and improved vision;
- Active safety measures for accident consequences mitigation;
- Intelligent systems for occupants' detection and protection and interior adjustments;
- Integrated and adaptive HMI for driver workload minimization;
- Emergency services research, with emphasis on info on accident severity, location, passenger and eventually the presence of any dangerous goods;

In addition, some more specific ideas have been included from various stakeholder representative organizations.

- Emphasis on further development of ADAS for driver's/rider's inattention, excessive workload, fatigue, drowsiness, alcohol abuse, illegal drugs use, medical drugs misuse (i.e. follow up of SENSATION and DRUID IPs [FERSI – ECTRI, FEHRL AND EPoSS];

- Individualized and personalized active safety systems, based upon driver's/rider's behaviour and driving/riding style [FERSI – ECTRI]. This is very close to the Adaptive HMI Concept [EPoSS]. Emphasis on ADAS adaptation for the elderly [HUMANIST];

- Active safety systems tailoring for clean vehicles [eSafetyForum];

- Adaptive light projection (using e.g. turning lights, projection, automatic light bean) for better road illumination for cars [EPoSS] and PTWs [FERSI].

4. CONCLUSIONS

The aim of this paper is to present the DETRA project and in particular the part of it related to the development of a pan-European Transport Research Work Programme. In order for this report to be finalized, more than 40 well-coordinated roadmaps and research work programmes for research and industry organizations have been collected and analysed. This procedure, which has been an ongoing one, has led to a report containing research priorities regarding the fields of Safety & Security, Congestion & Capacity and Environment & Energy of the Surface Transport modes. One of the next steps will involve the transition to the next level of detail, up to research task. This has been already the case, at least as far as the Road Safety area is concerned, since this report consists one of the inputs to the new project "Priorities for Road Safety Research in Europe" (PROS).

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