Evangelos Bekiaris
Marion Wiethoff
Evangelia Gaitanidou *Editors*

Infrastructure and Safety in a Collaborative World

Road Traffic Safety

Springer

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Preface by the Editors

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Dear Readers,

After 3 years of collaborative research (and a lot of fun!) in the IN-SAFETY research project, we found that a lot of good knowledge has been created, that should not be left "at the shelves". Some embryonic concepts when we conceived the IN-SAFETY ideas (back in 2003!) were later mainstreamed. "Self-explanatory roads", "forgiving roads", "cooperative systems" were still vague ideas when the project started in 2005, but are in the focus of current research. Thus, we at IN-SAFETY, feel pioneers. In reporting our cumulative knowledge, we strived to add more know-how from distinguished researchers outside IN-SAFETY, thus offering added value to the reader.

The book is conceptually composed of 5 parts and 19 chapters. After a preface by one of the leading figures in ITS research in Europe and beyond, Prof. G. Giannopoulos, head of CERTH/HIT, an introduction on the importance of Transport Research for Europe by the father of eSafety initiative, Jean-Pierre Médevielle, and a short intervention by the Director of POLIS (the agglomeration of over 65 Municipalities with telematic applications in Europe), Mr. Haon, the first part of the book focuses upon the methodological approaches adopted and applied in IN-SAFETY and beyond. The five Chapters of this part introduce a holistic approach of how to structure implementation scenarios towards self-explaining and forgiving roads, which abide to actual problems (related to specific accident types) and are prioritized by stakeholders in a structured and transparent way. The presented methodologies may be utilized by the reader for any further research and are viewed by us as "best practices" in introducing and prioritizing new safety measures.

The second part of the book deals with new developments in safety related tools, such as micro and macro models, risk analysis tools, use of driving simulators and tool-assisted driver and operators training. Each of its four Chapters is attributed to one of the above areas. It is worth mentioning that micro/macro simulation has primarily been developed for traffic efficiency and capacity studies and then moved to environmental impact studies. Its application to traffic safety in IN-SAFETY is thus innovative and was followed-up by further research. Also, in the training chapter, training tools and curricula are presented for many stakeholder groups,

such as driver trainees, professional drivers, road and other infrastructure operators, with emphasis on the use of multi-media and driving simulator tools for training optimization. Each of the proposed tool categories in these four chapters may thus be utilized in any relevant research.

The third and fourth parts present research results of specific forgiving (FOR) and self-explanatory (SER) road implementation scenarios (respectively), whether initiated and tested within IN-SAFETY, or not. There has been an effort to present a representative selection of measures. For FOR, the chapters cover lateral behavior, speed control, perception enhancement and several other individual interventions. For SER, the chapters focus upon standardization of icons and pictograms, context and text – into the so-called "Europeanisms" – as well as their ultimate personalization to the individual traveler language, needs and wants. There is a loose link with the implementation scenarios proposed in the first parts, the aim not being to present the own IN-SAFETY experiments but a selection of them, together with external ones, that altogether best represent the potential interventions in the FOR and SER domains.

The fifth and last part is presenting concepts and application examples on how to prioritize such implementation scenarios (given the limitations in funds and time of modern society), how to monetarily evaluate them, as well as suggestions on implementation guidelines and policies towards FOR and SER promotion. It should be emphasized that the future policy recommendations of Chapter 19 are the result of a wider stakeholders consultation within FERSI (Forum of European Road Safety Research Institutes, www.fersi.org), thus representing a consensus of over 21 Traffic Safety related Research Institutes Europewide.

For the rest parts, however, it should be also mentioned that the implementation scenarios priorities have taken into account only the views of the experts participating in the IN-SAFETY User Fora and rankings and opinions expressed there do not necessarily represent the views of the corresponding stakeholder communities. The same holds true for all the chapters, where all statements of each chapter represent the chapter authors' views and conclusions and for which no liability is assumed by the editors.

The editors wish hereby to thank all individual authors, as well as the IN-SAFETY Consortium in its entity and the corresponding EC services for their contributions to this book and the information included in it.

We hope that you, dear Reader, will enjoy reading it and will find something inside of your particular interest and value; a methodology, a tool, some data, a concept or an idea, that can facilitate your research needs, implementation or development plans and/or policy formulation interests.

Evangelos Bekiaris
Marion Wiethoff
Evangelia Gaitanidou

Preface by Prof. George Giannopoulos

The notion of safety in transportation goes hand in hand with efficiency, reliability, and other key concerns of our transport systems. In fact safety is the obvious top priority and primary concern in any transport system on land, sea, or air. So far, many years of research and practical experience from the implementation of specific policy actions, have given a wealth of information and data which can provide an invaluable source of reference material to all those involved in these issues in policy making and academia alike.

The IN-SAFETY research project (which my Institute had the honour of coordinating for all its three years of work), is certainly one such source. In fact it can rightfully be considered as one of the most original pieces of research in the field of transport safety and one that clearly aims at giving practical solutions and practical tools for improving road safety. The publication of this book, goes far beyond the normal obligations of the research Consortium in producing its contractual Deliverables, and shows clearly its commitment in pursuing their recommendations and making them available to the widest possible audience.

In its 19 chapters, the book provides the reader with a multitude of information, data, and suggestions for improving road safety. From the initial statistical analysis of safety data and accident statistics, to ways and means for improving the infrastructures, to ways to evaluate and prioritise road safety measures, and to the absolutely necessary training and education activities that must be the founding rock of any safety improvement effort.

Notions like the "self-explanatory roads", or the "forgiving roads", which were a cornerstone of the IN-SAFETY research work, are also presented. These, together with the views of experts (that participated in the various discussion fora organized by the project), and the policy recommendations that resulted from the consultation procedures with the 20 or so traffic safety related Institutes and Organisations that participated in the process, makes the material of the book quite unique, I would say.

In this way the reader is confronted with an array of ideas, opinions, and research results that will help him/her grasp the insides of this very difficult and complex problem.

As head of the National Transport research Organisation of Greece, a country with acute road and traffic safety problems, I am particularly happy to welcome this publication and I see it as a very useful tool for all those interested or involved in road safety.

G. A. Giannopoulos
Director, Hellenic Institute of Transport
Centre for Research and
Technology Hellas

Preface by Jean-Pierre Medevielle

As former Vice Chair of FERSI, current President of HUMANIST VCE, co-sponsored originally both by FERSI and ECTRI, both member of ERTRAC and eSafety Steering groups, it is a privilege to me to deliver some introductive remarks of the importance of Transport Research for Europe, including safety research as an integrated part.

Firstly, *the global competitiveness of Europe* is currently at stake; not only economic competitiveness of industries and operations, but also rule making and overall transport system as well as the transport research and/or education community competitiveness; obviously the new Grand Challenges are affecting this global competitiveness (climate change, energy, environment, sustainability, health and food).

Secondly, *transport is part of the problem and the solution*, so research and innovation have to be fostered and/or accelerated to solve or lighten the concrete problems in a vision and with a perspective towards the future.

Thirdly, *safety is an integrated part of transport in the road and aeronautics sectors*. As is obvious, both road and multimodal safety constitute a critical issue.

Fourthly, *on the scientific and technological side*, new technologies (ICT, nanotechnologies) are entering the transport system, the constituent components, services or products and their standardization. But there is also a need for integrated or system approach that draws on the agendas for soft research outcomes, such as HMI, economics, acceptance, innovation process and pathways, orgware research.[1] So, according to all models, "anticipation by research and the accompanying research for the transition" becomes a critical subject.

Fifthly, the Challenges lead to a requirement for an *increase of the European program dimensions* (both in their scope and funding) allocated to surface transport research. This should lead to greater contribution from and between EU programs, Joint Programming and national programming, and research innovation and education, as well as additions of new instruments in this perspective.

Sixthly, the needed response requires substantial investment for the *training and education* of professionals. If Europe *wants to keep or attract world R&D centres*,

[1]Research on organisational or institutional issues.

it is of overarching importance that a new generation of the *European transport scientific community* (scientists, engineers, and other staff) is created; replenishing and replacing but also growing industrial, commercial, public sector and academic research capacity.

Seventhly, it is of vital importance to *tackle the need for hard and soft research infrastructures*, providing the capabilities to address the challenges. This will include full-scale experimentation capabilities, addressing aspects, such as safety and climate change adaptation, as well as new simulation facilities and databases.

Eighthly, without *a strong integrated and dynamic European Research Area in the surface transport domain*, it could be difficult to tackle all these challenges.

IN-SAFETY project sets the scene for a new scientific holistic approach of promoting road safety through application of engineering sciences, ICT technologies, ergonomics and HMI sciences. As the definition and setting up of the next generation of transport infrastructure with its ICT and energy components is just ahead of us, strong research and innovation programs, such as IN-SAFETY, need to be created and funded in a proactive way, with the vehicle of tomorrow in mind and the driver.

But the *quest for excellence* in this domain is *not only the peer to peer evaluation of excellence*, but also the *relevance excellence,* determined by the outcomes achieved as well as the *governance and management excellence*, including scientific process or innovation processes.

Towards the future, we can see four critical issues of the Lyon Declaration, developing the Vision 2020 of the European Research Area for surface transport and confirmed for all scientific domains by the Lund Declaration and for ICT by the Visby Declaration:

- Mobility promotion as the fifth freedom
- New European Research Infrastructure creation
- Training and Education and European research partnership for the next generation of scientists and professionals
- Safety and Security Research intensification

Research priorities include the need for new methodologies, new databases, a new generation of field operational tests, and new scientific challenges for transport safety research: without a big development of Naturalistic Driving Studies and Distraction Research we cannot keep the European scientific competitiveness of transport safety research.

Jean-Pierre Medevielle
HUMANIST VCE Coordinator

Preface by Sylvain Haon

The European Road Safety Action Programme had set the objective of halving the number of deaths on European roads by 2010 in comparison to 2001. We now know that we have fallen short of achieving this target. Efforts to tackle this challenge should therefore be intensified. The main challenges of the years to come will be to bring more EU countries to the level of the Member States which have the safest roads and to continue to improve our overall ability to prevent accidents.

To do so, the focus of our concern should be on the individual, whether he/she is the driver, a passenger or another road user. Actions to prevent road accidents should continue to address all elements of the system, the vehicle, the infrastructure and the individual.

Awareness and educational campaigns should be reinforced and become systematic for all types of road users, as well as adapted to age and social conditions, in order to ensure maximum impact. The campaigns should cover the use of technology for all road users, especially car drivers, in view of the increasing range of technology available in the driving environment. This is necessary in order to ensure that the multiplication of messages given to the drivers, whether on board or by the infrastructure, does not induce dangerous distraction. They should be complemented by interventions in the infrastructure, of the type proposed in several chapters of this book, that lean towards the creation of forgiving road environments and self-explaining roads. This probably requires re-assessing the relationship between the vehicles and the infrastructure beyond traditional road intervention, and to consider holistically the three elements of road safety: infrastructure/driver/vehicles.

This book builds upon the research work conducted in the EC co-funded and sponsored (within the DG TREN workprogramme of the 6th Framework of the EC) IN-SAFETY (506716) project. The IN-SAFETY approach supports the safe use of information technology to strengthen road safety and, at the same time, contributes to more efficient mobility behaviour and pattern. It also acknowledges that work is required on the design and nature of messages to the driver. This should allow Europe to move progressively towards a pan-European electronic signing system, understandable by all drivers in all languages, including standardized pictograms and earcons for in-vehicle delivered messages and new/emerging ITS services.

The work of IN-SAFETY will facilitate the deployment of efficient road safety systems which are now still too rare. Intelligent Speed Adaption, for instance, has demonstrated its ability to reduce the number of accidents as well as, incidentally, to reduce CO_2 and local emissions from traffic. It has however made a very slow entrance on the market.

IN-SAFETY has demonstrated the possibility to make very significant progress. We can only call for further work on this topic, to accelerate research efforts, but also to support their more rapid deployment on the market. We call for European initiatives to pursue these efforts and stimulate the deployment of the solutions which have proved effective in reducing the number of accidents and fatalities on our roads. This should be supported by the necessary regulatory initiatives at the European level and by large-scale communication campaigns.

Sylvain Haon
Executive Director of POLIS
(European cities and regions networking for
innovative transport solutions)

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Furthermore, IN-SAFETY was a project sponsored and promoted by FERSI, the Forum of European Road Safety Institutes; an Association of 21 Road Safety Research Institutes, from 21 European countries. Thus, FERSI Members' support is acknowledged too.

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Abbreviations

ACC	Adaptive Cruise Control
ADAS	Advanced Driver Assistant System
ADR	Agreement on Dangerous Goods by Road
AHP	Analytical Hierarchical Process
AMI	Advanced Motorway Indicator
ARAS	Advanced Rider Assistant System
ATM	Active Traffic Management
AWS	Advanced Warning System
BC ratio	Benefic–Cost Ratio
CACC	Cooperative Advanced Cruise Control
CAS	Collision Avoidance System
CAT	Comprehension Test Animated Pictogram
CBA	Cost Benefit Analysis
CC	Cruise Control
CCD	Charge Coupled Device
CE ratio	Cost Effectiveness Ratio
CEA	Cost Effectiveness Analysis
CMOS	Complementary Metal Oxide Semiconductor
CRIM	Cluster of Repositories for IN-SAFETY Messages
CST	Content Structure Test
CWS	Collision Warning System
DALY	Disability – Adjusted Life-Year
DATEX	Data Exchange Service
DG	Dangerous Goods
DG	Directorate General (of the EC)
DLC	Distance to Line Crossing
DLL	Dynamic Link Library
DOT	Department of Transport (of the US)
DRAM	Darmstadt Risk Analysis Method
DRAT	Darmstadt Risk Analysis Tool
DSRC	Dedicated Short Range Communications
DSS	Decision Support System