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Volume 4

Traffic Safety

**Edited by
George Yannis and Simon Cohen**

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Traffic Safety

Research for Innovative Transports Set

coordinated by
Bernard Jacob

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Edited by
George Yannis
Simon Cohen

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Contents

| | |
|---|-------|
| Acknowledgments | xvii |
| Preface | xix |
| Introduction | xxiii |
| George YANNIS and Simon COHEN | |
| Part 1. Road Safety Policy | 1 |
| Chapter 1. Analysis of Road Safety Management Systems in Europe | 3 |
| Nicole MUHLRAD, Gilles VALLET, Ilona BUTLER, Victoria GITELMAN, Etti DOVEH, Emmanuelle DUPONT, Heike MARTENSEN, Pete THOMAS, Rachel TALBOT, Eleonora PAPADIMITRIOU, George YANNIS, Luca PERSIA, Gabriele GIUSTINIANI, Klaus MACHATA and Charlotte BAX | |
| 1.1. Introduction | 3 |
| 1.2. Methodology | 4 |
| 1.2.1. Road safety management investigation model | 4 |
| 1.2.2. Data collection and handling | 5 |
| 1.3. Qualitative analyses of road safety management systems in Europe | 7 |
| 1.3.1. Road safety management profiles | 7 |
| 1.3.2. Summary of country analyses | 8 |
| 1.4. Quantitative analyses | 11 |

| | |
|--|----|
| 1.4.1. Clustering of countries on the basis of road safety management components | 12 |
| 1.4.2. Statistical models linking road safety management with road safety performance | 13 |
| 1.5. Conclusion | 15 |
| 1.6. Key messages and recommendations | 15 |
| 1.7. Acknowledgments | 16 |
| 1.8. Bibliography | 17 |

Chapter 2. Conceptualizing Road Safety Management through a Territorialized Complex System: Context and Goals

19

Thierry SAINT-GÉRAND, Mohand MEDJANE, Abdelkrim BENSARD,
Dominique FLEURY, Jean-François PEYTAVIN, Eliane PROPECK-ZIMMERMANN and Maroua
BOUZID

| | |
|---|----|
| 2.1. Introduction | 19 |
| 2.2. Methodological challenge: integration of different road safety concepts into territorial complex system modeling. | 20 |
| 2.3. A practical example: ZIVAG | 27 |
| 2.4. Conclusion and followings | 30 |
| 2.5. Bibliography | 32 |

Chapter 3. Development of the European Road Safety Knowledge System

35

George YANNIS, Pete THOMAS, Nicole MUHLRAD,
Heike MARTENSEN, Emmanuelle DUPONT, Letty AARTS,
Petros EVGENIKOS and Eleonora PAPADIMITRIOU

| | |
|---|----|
| 3.1. Introduction | 35 |
| 3.2. Data/knowledge collecting and processing | 37 |
| 3.2.1. Assembly of road safety data | 37 |
| 3.2.2. Assembly of road safety knowledge. | 40 |
| 3.3. Key road safety analyses and summaries | 42 |
| 3.3.1. Annual Statistical Report and Basic Road Safety Fact Sheets | 42 |
| 3.3.2. Country overviews | 43 |
| 3.3.3. Road safety management profiles | 44 |
| 3.3.4. Forecast fact sheets | 45 |
| 3.3.5. Summaries on key road safety issues/web-texts | 45 |
| 3.3.6. Integrated road safety knowledge system. | 46 |
| 3.4. Conclusion and next steps. | 48 |
| 3.5. Acknowledgments | 49 |
| 3.6. Bibliography | 49 |

Part 2. Accident Analysis and Modeling 51
**Chapter 4. Structural Time Series Modeling
of the Number of Fatalities in Poland in Relation
to Economic Factors 53**

Ruth BERGEL-HAYAT and Joanna ZUKOWSKA

| | |
|--|----|
| 4.1. Introduction | 53 |
| 4.1.1. Context. | 53 |
| 4.1.2. Research question and objective of the study. | 55 |
| 4.2. Current state of knowledge | 56 |
| 4.3. Methodology | 57 |
| 4.4. The data. | 58 |
| 4.4.1. Mortality and economic indicators | 58 |
| 4.4.2. Weather for explaining the outliers | 59 |
| 4.4.3. Graphical analysis | 60 |
| 4.5. Results | 65 |
| 4.6. Discussion | 66 |
| 4.7. Conclusion and outlook | 66 |
| 4.8. Bibliography | 67 |

**Chapter 5. Risk of Road Traffic Injuries for
Pedestrians, Cyclists, Car Occupants and
Powered Two-Wheel Users, based on a Road
Trauma Registry and Travel Surveys, Rhône, France 69**

 Stéphanie BLAIZOT, Francis PAPON, Mohamed
MOULOUD HADDAK and Emmanuelle AMOROS

| | |
|---|----|
| 5.1. Introduction | 69 |
| 5.2. Material and methods | 70 |
| 5.2.1. Hospital-based crash data: the Rhône road trauma registry | 70 |
| 5.2.2. The regional travel survey | 71 |
| 5.2.3. Seasonality correction | 71 |
| 5.2.4. Location: dense and non-dense areas | 72 |
| 5.2.5. Injury rates. | 72 |
| 5.2.6. Trends of injury rates. | 72 |
| 5.3. Results and interpretation | 73 |
| 5.3.1. Seasonality ratios | 73 |
| 5.3.2. Injury rates. | 73 |
| 5.3.3. Trends | 80 |
| 5.4. Discussion and conclusions | 81 |
| 5.4.1. Study limitations | 81 |
| 5.4.2. Study strengths | 82 |

| | |
|--------------------------------|----|
| 5.4.3. Conclusions | 82 |
| 5.5. Acknowledgments | 83 |
| 5.6. Bibliography | 83 |

Chapter 6. Development of Safety Performance Functions for Two-Lane Rural First-Class

| | |
|--|-----------|
| Main Roads in Hungary | 87 |
|--|-----------|

Atila BORSOS, John N. IVAN and Gyula OROSZ

| | |
|---|----|
| 6.1. Introduction | 87 |
| 6.2. Literature review | 88 |
| 6.3. General overview of first-class main roads | 89 |
| 6.3.1. Design characteristics | 89 |
| 6.3.1. Accident statistics | 90 |
| 6.4. Data collection and segmentation | 91 |
| 6.5. Modeling | 92 |
| 6.5.1. Regression technique and goodness of fit | 92 |
| 6.5.2. Modeling results | 93 |
| 6.6. Discussion and conclusions | 98 |
| 6.7. Acknowledgments | 99 |
| 6.8. Bibliography | 99 |

| | |
|--|------------|
| Part 3. Vulnerable Road Users' Safety | 101 |
|--|------------|

Chapter 7. Mobility and Safety of Powered Two-Wheelers in OECD Countries

| | |
|--|-----|
| | 103 |
|--|-----|

Pierre VAN ELSLANDE, Veronique FEYPELL-DE LA BEAUMELLE,
James HOLGATE, Kris REDANT, Hélène DE SOLÈRE, Dimitris MARGARITIS,
George YANNIS, Eleonora PAPADIMITRIOU, Saskia DE CRAEN,
Lars INGE HASLIE, Juan MUGUIRO and Per-Olov GRUMMAS GRANSTRÖM

| | |
|--|-----|
| 7.1. Introduction | 103 |
| 7.2. Mobility and safety figures of PTWs | 105 |
| 7.2.1. PTW mobility and use | 105 |
| 7.2.2. Safety development over time | 105 |
| 7.2.3. Crash characteristics and scenarios | 106 |
| 7.3. Contributory factors of PTW crashes | 108 |
| 7.4. Toward an integrated road safety strategy for PTW | 109 |
| 7.4.1. The safe systems approach | 109 |
| 7.4.2. PTWs in the safe system | 110 |
| 7.5. Measures for PTW safety improvement | 111 |
| 7.5.1. Licensing, training and education | 111 |
| 7.5.2. Enforcement and communication | 111 |
| 7.5.3. Infrastructure and traffic management | 112 |
| 7.5.4. Vehicles, ITS and protective devices | 113 |

| | |
|---|-----|
| 7.6. Key messages and recommendations | 113 |
| 7.7. Bibliography | 115 |

Chapter 8. Comparison of Car Drivers' and Motorcyclists' Drink Driving in 19 Countries: Results from the SARTRE 4 Survey 119

Julien CESTAC, Cécile BARBIER, Gian-Marco SARDI,
Richard FREEMAN, Sami KRAÏEM and Jean-Pascal ASSAILLY

| | |
|-------------------------------------|-----|
| 8.1. Introduction | 119 |
| 8.2. Method | 120 |
| 8.2.1. The SARTRE surveys | 120 |
| 8.2.2. Procedure | 121 |
| 8.2.3. Sample | 121 |
| 8.2.4. Measures. | 121 |
| 8.3. Results | 122 |
| 8.4. Discussion | 126 |
| 8.5. Acknowledgments | 127 |
| 8.6. Bibliography | 128 |

Chapter 9. Trajectories of Multiple People in Crowds Using Laser Range Scanner. 131

Ladji ADIAVIAKOYE, Patrick PLAINCHAULT,
Marc BOURCERIE and Jean-Michel AUBERLET

| | |
|---|-----|
| 9.1. Introduction | 131 |
| 9.2. Approach | 132 |
| 9.2.1. Measurement system | 132 |
| 9.2.2. Data fusion | 134 |
| 9.2.3. Background subtraction | 134 |
| 9.2.4. Control points | 134 |
| 9.2.5. Image registration. | 136 |
| 9.3. Detection | 137 |
| 9.4. Multiple tracking. | 139 |
| 9.5. Experimental results. | 140 |
| 9.6. Conclusions | 142 |
| 9.7. Bibliography | 142 |

Chapter 10. Safety of Urban Cycling: A Study on Perceived and Actual Dangers 145

Anita GRASER, Michael ALEKSA, Markus STRAUB,
Peter SALEH, Stephan WITTMANN and Gernot LENZ

| | |
|--|-----|
| 10.1. State of urban cycling | 145 |
| 10.2. Perceived safety of urban cycling. | 148 |

| | |
|--|-----|
| 10.3. The Austrian accident database | 151 |
| 10.4. Comparison of perceived safety and recorded accidents | 153 |
| 10.4.1. Regional aspects | 153 |
| 10.4.2. Location characteristics | 155 |
| 10.5. Conclusion and outlook | 157 |
| 10.6. Acknowledgments | 158 |
| 10.7. Bibliography | 158 |

Part 4. Road Infrastructure Safety 161

Chapter 11. Speed Distribution and Traffic Safety Measures. 163

Anna VADEBY and Åsa FORSMAN

| | |
|---|-----|
| 11.1. Introduction and aim of the study | 163 |
| 11.2. Method | 165 |
| 11.2.1. Data | 165 |
| 11.2.2. Measures | 166 |
| 11.2.3. The Power model | 167 |
| 11.3. Results. | 167 |
| 11.3.1. Speed distribution | 167 |
| 11.3.2. Speed measures | 170 |
| 11.3.3. Relative risks. | 173 |
| 11.4. Discussion. | 173 |
| 11.5. Acknowledgments | 175 |
| 11.6. Bibliography | 175 |

Chapter 12. Ex-ante Assessment of a Speed Limit Reducing Operation – A Data-driven Approach 177

Maurice ARON, Régine SEIDOWSKY and Simon COHEN

| | |
|---|-----|
| 12.1. Introduction | 177 |
| 12.2. Method for predicting the injury or fatality accident count | 178 |
| 12.2.1. Accident analysis | 178 |
| 12.2.2. Empirical speed analysis | 179 |
| 12.2.3. Traffic conditions prediction | 179 |
| 12.2.4. Calibration of the average speed–accident and density–accident relationships | 180 |
| 12.3. The part of the ALLEGRO motorway network concerned with speed limit reduction | 183 |
| 12.4. <i>Ex-ante</i> assessment results of the speed decrease in the ALLEGRO motorway network. | 184 |

| | |
|--|-----|
| 12.4.1. FDs on the ALLEGRO network | 184 |
| 12.4.2. Splitting the accidents into three types and predictions. | 185 |
| 12.5. The threefold validation of the approach. | 190 |
| 12.5.1. Validation of the models | 191 |
| 12.5.2. Validation of the calibrations. | 191 |
| 12.5.3. Verification/validation of the use of the models | 192 |
| 12.6. Conclusions. | 192 |
| 12.7. Appendix: relationships between injury accidents and traffic conditions estimated from the Marius network | 193 |
| 12.7.1. The Marius network of urban motorways near Marseille | 193 |
| 12.7.2. The Power and Exponential models, logit form. | 194 |
| 12.7.3. Values of the coefficients of significant relationships (single vehicle accidents, daytime) | 194 |
| 12.7.4. Values of the coefficients of significant relationships (multiple vehicles crashes, daytime) | 196 |
| 12.7.5. Acknowledgments. | 197 |
| 12.8. Bibliography | 197 |

Chapter 13. Development of a Guideline for the Selection of Vehicle Restraint Systems – Identification of the Key Selection Parameters

199

Francesca La TORRE, Ceki ERGINBAS, Robert THOMSON,
Giuseppina AMATO, Bine PENGAL, Peter SALEH,
Chris BRITTON and Kris REDANT

| | |
|---|-----|
| 13.1. Introduction | 199 |
| 13.2. Objectives of the first work package of the SAVeRS project | 201 |
| 13.3. Collation and examination of national guidelines and standards | 201 |
| 13.3.1. Methodology. | 201 |
| 13.3.2. Results | 203 |
| 13.4. Collation and examination of published literature. | 204 |
| 13.4.1. Aim | 204 |
| 13.4.2. Methodology. | 204 |
| 13.4.3. Results | 206 |
| 13.5. Conclusions. | 211 |
| 13.6. Acknowledgments | 212 |
| 13.7. Follow-up | 212 |
| 13.8. Bibliography | 213 |

Chapter 14. For the Vision of “Zero Accidents at Intersections”: A Challenge between Road Safety and Capacity 217

Jean Emmanuel BAKABA and Jörg ORTLEPP

| | |
|---|-----|
| 14.1. Introduction | 217 |
| 14.2. Traffic turning left at signal-controlled intersections | 218 |
| 14.2.1. Non-conflicting and conflicting flows | 218 |
| 14.2.2. Traffic turning left as conflicting streams | 219 |
| 14.2.3. Traffic turning left as partially conflicting streams | 219 |
| 14.2.4. Selecting cases for investigation | 219 |
| 14.2.5. Initial conditions for the calculations | 220 |
| 14.2.6. Results of the simulation calculations | 220 |
| 14.3. Recommendations | 230 |
| 14.4. Conclusion | 231 |
| 14.5. Bibliography | 232 |

Chapter 15. Safety Inspection and Management of the Road Network in Operation 233

Salvatore CAFISO, Alessandro DI GRAZIANO, Grazia LA CAVA
and Giuseppina PAPPALARDO

| | |
|--|-----|
| 15.1. Introduction | 233 |
| 15.2. Road safety inspection tools in Europe | 235 |
| 15.2.1. Tool for SI in Austria | 235 |
| 15.2.2. Tool for SI in Norway | 235 |
| 15.2.3. Tool for SI in Ireland | 237 |
| 15.3. Design of new software tools for road inspection | 239 |
| 15.3.1. IASP procedure | 239 |
| 15.3.2. Hardware and software tools for in-office inspection | 240 |
| 15.3.3. Data Analysis Module for in office review | 243 |
| 15.3.4. Optimization tool, SAFOPT | 243 |
| 15.4. Case study. | 246 |
| 15.5. Conclusion | 248 |
| 15.6. Bibliography | 248 |

Part 5. ITS and Safety 251

Chapter 16. Improving Safety and Mobility of Vulnerable Road Users Through ITS Applications 253

Johan SCHOLLIERS, Daniel BELL, Andrew MORRIS,
Alejandra Beatriz GARCÍA MELÉNDEZ and Oscar Martin PEREZ

| | |
|------------------------------|-----|
| 16.1. Introduction | 253 |
| 16.2. Methodology | 254 |

| | |
|--|-----|
| 16.3. Accident data analysis and identification of critical scenarios | 256 |
| 16.3.1. Pedestrians | 256 |
| 16.3.2. Cyclists | 257 |
| 16.3.3. PTWs | 258 |
| 16.4. User needs analysis. | 258 |
| 16.5. ITS applications for the critical scenarios and user needs. | 260 |
| 16.6. Results. | 260 |
| 16.7. Conclusions. | 265 |
| 16.8. Acknowledgments | 268 |
| 16.9. Bibliography | 268 |

Chapter 17. Experimentation with the PRESERVE VSS and the Score@F System 271

Rim MOALLA, Brigitte LONC, Gerard SEGARRA,
Marcello LAGUNA, Panagiotis PAPADIMITRATOS,
Jonathan PETIT and Houda LABIOD

| | |
|---|-----|
| 17.1. Introduction | 271 |
| 17.2. Test methodology | 273 |
| 17.3. Performance indicators | 274 |
| 17.4. Test environment. | 274 |
| 17.4.1. Score@F applications and platform | 274 |
| 17.4.2. PRESERVE system | 276 |
| 17.4.3. Test site description | 277 |
| 17.5. Test case description. | 278 |
| 17.5.1. Functional tests | 278 |
| 17.5.2. Attack tests. | 280 |
| 17.6. Test results | 281 |
| 17.7. Conclusion | 281 |
| 17.8. Acknowledgments | 282 |
| 17.9. Bibliography | 282 |

Chapter 18. Safety Bus Routing for the Transportation of Pupils to School 283

Eleni CHALKIA, Josep Maria SALANOVA GRAU, Evangelos BEKIARIS,
Georgia AYFANDOPOULOU, Chiara FERARINI and Evangelos MITSAKIS

| | |
|--|-----|
| 18.1. Introduction | 283 |
| 18.2. The school bus routing problem. | 284 |
| 18.3. Methodology for solving the SBRP in SAFEWAY2SCHOOL. | 285 |
| 18.3.1. SAFE MAP | 286 |

| | |
|--|-----|
| 18.3.2. Safety criteria used in the presented methodology | 287 |
| 18.3.3. Pedestrian routing | 290 |
| 18.3.4. School bus routing. | 291 |
| 18.4. Application to Thessaloniki | 294 |
| 18.5. Conclusions. | 297 |
| 18.6. Acknowledgments | 298 |
| 18.7. Bibliography | 298 |

**Chapter 19. Spreading Awareness of Traffic Safety
through Web Application.** 301

Miha AMBROŽ, Jernej KORINŠEK and Ivan PREBIL

| | |
|--|-----|
| 19.1. Introduction. | 301 |
| 19.2. Current state of traffic accident data in Slovenia | 302 |
| 19.2.1. The Traffic Accident Database. | 302 |
| 19.2.2. Infrastructure data | 303 |
| 19.2.3. System problems with the current dataset. | 305 |
| 19.3. Identification of conflict points | 307 |
| 19.4. Application structure. | 308 |
| 19.4.1. Server components | 309 |
| 19.4.2. User interface | 309 |
| 19.5. Use of the web application | 312 |
| 19.5.1. Examples. | 313 |
| 19.6. Conclusion | 315 |
| 19.7. Acknowledgments | 316 |
| 19.8. Bibliography | 316 |

Part 6. Railway Safety 317

**Chapter 20. Overview of Freight Train Derailments
in the EU: Causes, Impacts, Prevention
and Mitigation Measures** 319

Cristian ULIANOV, François DEFOSSEZ, Gordana VASIĆ FRANKLIN
and Mark ROBINSON

| | |
|---|-----|
| 20.1. Introduction. | 319 |
| 20.2. Research methodology. | 320 |
| 20.3. Results and discussion | 322 |
| 20.3.1. Derailment trends | 322 |
| 20.3.2. Analysis of derailment causes | 322 |
| 20.3.3. Impact analysis | 325 |
| 20.3.4. Overview of prevention and monitoring systems for reducing the occurrence of derailments | 327 |

| | |
|---|-----|
| 20.3.5. Assessment of existing prevention and monitoring systems | 331 |
| 20.3.6. Gap analysis and overview of emerging technologies | 332 |
| 20.4. Conclusions and recommendations | 334 |
| 20.5. Acknowledgment. | 335 |
| 20.6. Bibliography | 335 |

Chapter 21. A Risk Assessment Tool for Public Transportation 337

Andrea SOEHNCHEN and Mihai BARCANESCU

| | |
|--|-----|
| 21.1. Security – a growing concern for Public Transport operators | 337 |
| 21.2. The risk assessment procedure | 338 |
| 21.2.1. A tool developed to mitigate security risks | 338 |
| 21.2.2. Definition and terminology | 339 |
| 21.2.3. Preliminary steps in conducting risk assessment | 340 |
| 21.2.4. Risk identification | 341 |
| 21.2.5. Risk analysis | 342 |
| 21.2.6. Risk evaluation | 344 |
| 21.2.7. Risk mitigation. | 345 |
| 21.2.8. Support tools. | 345 |
| 21.3. Conclusions. | 345 |
| 21.4. Acknowledgments | 346 |
| 21.5. Bibliography | 346 |

Chapter 22. The GETAWAY Project – Improving Passenger Evacuation Techniques in Railway Stations (and Other Transport Hubs) 347

Paul BRYANT and Christos GIACHRITSIS

| | |
|--|-----|
| 22.1. Introduction | 347 |
| 22.2. External factors. | 349 |
| 22.3. Objectives of the GETAWAY project | 350 |
| 22.4. The GETAWAY system concept | 351 |
| 22.5. The GETAWAY-IADSS development. | 354 |
| 22.6. The Active Dynamic Signage System (ADSS) | 355 |
| 22.7. Fire Detection System (FDS) development | 356 |
| 22.8. CCTV Analysis Engine (CAE) | 357 |
| 22.9. Decision Engine (DE) and Evacuation Simulation Engine (ESE) | 357 |
| 22.10. The level of IADSS application | 358 |
| 22.11. Evaluation of the GETAWAY system | 359 |

| | |
|----------------------------------|-----|
| 22.12. Conclusion. | 363 |
| 22.13. Acknowledgments | 364 |
| 22.14. Bibliography. | 364 |

Chapter 23. Interpretive Structural Modeling of Security Systems for Better Security

| | |
|---|------------|
| Management in Railways | 367 |
|---|------------|

Anoop SRIVASTAVA, Sanjeev SWAMI and Devender BANWET

| | |
|--|-----|
| 23.1. Introduction. | 367 |
| 23.2. Complexity of railway systems | 368 |
| 23.3. Nominal Group Technique (NGT) | 369 |
| 23.4. Interpretive Structural Modeling (ISM) | 370 |
| 23.4.1. Interpretive Structural Modeling for Indian Railway Security System | 372 |
| 23.5. Policy implications. | 376 |
| 23.6. Conclusions and avenues for future research | 376 |
| 23.7. Acknowledgments | 377 |
| 23.8. Bibliography | 377 |

| | |
|----------------------------------|------------|
| List of Authors | 379 |
|----------------------------------|------------|

| | |
|------------------------|------------|
| Index | 387 |
|------------------------|------------|

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Preface

The transport sector is very much concerned about environmental adaptation and mitigation issues. Most of these are related to the objective of curbing GHG emission by 20% by 2020, alternative energy and energy savings, sustainable mobility and infrastructures, safety and security, etc. These objectives require the implementation of advanced research work to develop new policies, and to adjust education and industrial innovations.

The theme and slogan of the Transport Research Arena held in Paris (TRA2014) were respectively: “Transport Solutions: From Research to Deployment” and “Innovate Mobility, Mobilise Innovation”. Top researchers and engineers, as well as private and public policy and decision-makers, were mobilized to identify and take the relevant steps to implement innovative solutions in transport. All surface modes were included, including walking and cycling, as well as cross modal aspects.

Policies, technologies and behaviors must be continually adapted to new constraints, such as climate change, the diminishing supply of fossil fuels, the economic crisis, the increased demand for mobility, safety and security, i.e. all the societal issues of the 21st Century. Transport infrastructures and materials, modal share, co-modality, urban planning, public transportation and mobility, safety and security, freight, logistics, ITS, energy and environment issues are the subject of extensive studies, research work and industrial innovations that are reported in this series of books.

This book is a part of a set of six volumes called the *Research for Innovative Transports* set. This collection presents an update of the latest academic and applied research, case studies, best practices and user perspectives on transport carried out in Europe and worldwide. The presentations made during TRA2014 reflect on them. The TRAs are supported by the European Commission (DG-MOVE and DG-RTD),

the Conference of European Road Directors (CEDR) and the modal European platforms, ERRAC (rail), ERTRAC (road), WATERBORNE, and ALICE (freight), and also by the European Construction Technology Platform (ECTP) and the European Transport Research Alliance (ETRA).

The volumes are made up of a selection of the best papers presented at the TRA2014. All papers were peer reviewed before being accepted at the conference, and they were then selected by the editors for the purpose of the present collection. Each volume contains complementary academic and applied inputs provided by highly qualified researchers, experts and professionals from all around the world.

Each volume of the series covers a strategic theme of TRA2014.

Volume 1, *Energy and Environment*, presents recent research work around the triptych “transports, energy and environment” that demonstrate that vehicle technologies and fuels can still improve, but it is necessary to prepare their implementation (electromobility), think about new services and involve enterprises. Mitigation strategies and policies are examined under different prospective scenarios, to develop and promote alternative fuels and technologies, multi-modality and services, and optimized transport chains while preserving climate and the environment. Evaluation and certification methodologies are key elements for assessing air pollution, noise and vibration from road, rail and maritime transports, and their impacts on the environment. Different depollution technologies and mitigation strategies are also presented.

Volume 2, *Towards Innovative Freight and Logistics*, analyzes how to optimize freight movements and logistics; it introduces new vehicle concepts, points out the governance and organization issues, and proposes an assessment framework.

Volumes 3 and 4 are complementary books covering the topic of traffic management and safety.

Volume 3, *Traffic Management*, starts with a survey of data collection processes and policies and then shows how traffic modeling and simulation may resolve major problems. Traffic management, monitoring and routing tools and experience are reported and the role of traffic information is highlighted. Impact assessments are presented.

Volume 4, *Traffic Safety*, describes the main road safety policies, accident analysis and modeling. Special focus is placed on the safety of vulnerable road users. The roles of infrastructure and ITS in safety are analyzed. Finally railway safety is focused upon.

Volume 5, *Materials and Infrastructures*, is split into two sub-volumes, investigating geotechnical issues and pavement materials' characterization, innovative materials, technologies and processes and introducing new techniques and approaches for auscultation and monitoring. Solutions to increase the durability of infrastructures and to improve maintenance and repair are presented, for recycling as well as for ensuring the sustainability of the infrastructures. Specific railways and inland navigation issues are addressed. A focus is put on climate resilient roads.

Volume 6, *Urban Mobility and Public Transport*, highlights possible innovations in order to improve transports and the quality of life in urban areas. Buses and two-wheelers could be a viable alternative in cities if they are safe and reliable. New methodologies are needed to assess urban mobility through new survey protocols, a better knowledge of user behavior or taking into account the value of travel for public transport. The interactions between urban transport and land planning are a key issue. However, these interactions have to be better assessed in order to propose scenarios for new policies.

Bernard JACOB, Chair of the TRA2014 Programme Committee

Jean-Bernard KOVARIK, Chair of the TRA2014 Management Committee

March 2016

Introduction

Advances in telecommunications and information technologies are changing the practices used in both everyday life and in professional life. The transport world, sensitive to innovation, does not escape this movement.

Our daily environment demonstrates successful mutations. New equipment is deployed along the roads or on board vehicles. Variable message signs display real-time travel times. Cameras detect incidents and trigger alerts. Information terminals provide service schedules and waiting times for buses or trains. Other technologies facilitate the management of daily travel, making it more reliable, safer and more comfortable.

These developments highlight various aspects of advanced traffic management as well as transport safety. Behind, there is transport research. Its role is to imagine, assess and support the emergence of new approaches and innovative systems. Multi-disciplinary by essence, transport research is well adapted to deal with these issues. This is the purpose of this volume resulting from the international TRA2014 Conference, held in Paris in April 2014. The Conference was organized under the sign of the transition from *Research to deployment in Transport solutions*.

The topic of traffic is organized in two separate but complementary volumes: Volume 3 on Traffic Management and Volume 4 on Traffic Safety; both presenting a selection of papers in the aforementioned fields. As a major event on transport in Europe, the conference covered a broad range of issues linked to Traffic Management and Safety. Naturally, the shortlist presented in these two volumes does not cover the wide spectrum of these areas. It aims to highlight its diversity through a choice of updated papers from the conference. Selection is primarily based

on a quality criterion, also taking into account the geographical diversity of papers in order to restore the originality and richness of the current research.

Main findings

The selected 23 chapters that are included in this volume on traffic safety demonstrate how technological innovations as well as new methodologies applied to transport safety can modify usual practices and offer efficient solutions to the ongoing challenges of safety considerations, needs of vulnerable road users, environmental issues and economical constraints. Both theoretical papers and practical case studies explore topics such as road safety management and policies, accident analysis and modeling, vulnerable road users' safety, road infrastructure safety, ITS and railway safety.

Nowadays, the issue of road safety plays an increasingly important role in traffic and mobility planning and management. In the European Union, systematic efforts for gathering and harmonizing road safety data at the European level have led to a significant upgrade and enhancement of the EU databases, supporting decision-making of both national and international authorities and stakeholders. The availability of detailed, high-quality road safety data is a prerequisite for accident analysis and modeling that can investigate the evolution of road fatalities and casualties, identify the risk of road injuries or allow the development of accident prediction models.

Vulnerable road users require special attention as far as safety is concerned. Innovative research methodologies, such as the use of scanners to track the trajectories of multiple pedestrians in a crowd open new fields of research that can eventually assist in the improvement of pedestrians' safety. Furthermore, the rising popularity of cycling as a means of transportation in urban environments necessitates the re-evaluation of aspects of road design and operation, e.g. at intersections, in order to properly accommodate cyclists' needs.

Speed management is an important issue in road safety, with a direct link to accident severity. Relevant research plays an important role in the evaluation of speed related measures, based on the availability of data for reliable statistical analyses.

The concepts of the safe system approach and the vision of zero accidents are becoming increasingly accepted by researchers, road safety practitioners and stakeholders internationally, and, within these concepts, the challenge to combine road safety with efficient traffic operations and capacity is investigated and promoted to decision makers.

The expansion of ITS applications to vulnerable road users (pedestrians, children travelling to/from school etc.), security and privacy issues related to ITS and the exploitation of further applications such as spreading public awareness of traffic safety seem to be some of the challenges that are currently investigated.

Research in railways safety also indicates that there is a significant potential for improvement, considering the latest technical innovations and developments. Innovative systems are being developed to assist railway management with regards to safety (e.g. evacuation of passengers) and new risk assessment methodologies are presented to help in risk identification and setting priorities.

This fourth volume, extracted from the TRA Conference 2014, will interest both the research and higher education communities, professionals in the management of road and rail traffic, economic and institutional decision-makers increasingly solicited on new forms of transport management. They will find both the state of the art of some key issues, chapters on various methods and illustrative case studies.

This volume on traffic safety includes six parts, covering aspects such as road safety management and policies, accident analysis and modelling, vulnerable road users' safety, road infrastructure safety, ITS and safety as well as railway safety.

Part 1 deals with safety management in general, road safety policy and strategy and development of road safety knowledge systems. Researchers and decision makers can find a thorough investigation and analysis of road safety management in European countries, as well as a presentation of the European Road Safety Knowledge System that includes a wealth of data on road safety and various analyses results. Furthermore, decision makers may be interested in user-friendly tools allowing to integrate traffic safety in urban mobility plans.

Part 2 deals with detailed statistical analysis of accident data, in order to identify or understand road safety critical issues and develop accident models. The issue of the evolution of the number of road fatalities in Poland, in relation to economic factors, is presented, along with an analysis aiming to identify the risk of road traffic injuries for pedestrians, cyclists, car occupants and PTW riders in Rhône, France, based on a road trauma registry and travel surveys. Furthermore, interesting accident prediction models for main rural roads in Hungary are developed, with imminent and obvious practical applications.

Part 3 discusses road safety issues of vulnerable road users: pedestrians, cyclists, young drivers and PTWs. Decision makers will find the analysis of PTW mobility and safety in the OECD countries useful, which concludes in a number of measures integrated with the development of a safe system approach. Research methodologies are proposed to track multiple people in crowds of pedestrians. Finally, analysis of

the results of two interesting surveys is presented: one on the patterns of drink driving processes for car drivers and motorcyclists and another on the perceived risk of urban cycling.

Part 4 refers to road infrastructure safety, with particular focus on speed limits, road restraint systems, infrastructure safety management, and various design issues. The part includes both theoretical and practical issues; a comprehensive review on the application of Vehicle Restraint Systems, evaluations of implemented safety measures, such as speed related measures in Sweden, and investigation of traffic signalization issues. Also, a presentation of a data-driven approach to assess the safety effects of a speed limit reducing operation before its implementation can be of assistance to road safety practitioners and decision makers, and the development of software tools for Road Safety Inspections can assist road agencies in the selection of road infrastructure rehabilitation and maintenance projects.

Part 5 explores the use, effectiveness and acceptability of Intelligent Transportation Systems (ITS) technologies in road safety. It focuses on safety and mobility impacts of ITS applications for vulnerable road users, on security and privacy enhancing technologies, on the development of routing algorithms and on the development of a web application to increase public awareness of the state of traffic safety.

Finally, Part 6 discusses railway safety, and includes a comprehensive overview of recent mainline freight train derailments in Europe, the proposal of a risk assessment methodology, and a discussion on the application of Interpretive Structural Modelling (ISM) to security systems in Indian Railways. Furthermore, a system conceived to provide additional clarification and guidance for the evacuation of large numbers of persons within a railway station during an emergency may prove useful to railway safety managers.

Conclusion

The work gathered in this volume provides an insight into research, best practices and transport policies with focus on state-of-the-art advances in the field of traffic safety. They demonstrate the progress made in the various processes of data collection, modeling, management, information and assessment, assisting academics, transport professionals, practitioners and decision makers to a better understanding of the current and future trends. The crucial and increasing role of

ITS applications becomes evident, and more frequently researchers and practitioners are applying a universal approach and interdisciplinary methodologies to address transport related issues, including global approaches in modeling. Furthermore, special focus is given to sustainability of presented traffic and safety solutions with special emphasis to the needs of vulnerable road users and to new concepts such as the safe system approach.

PART 1

Road Safety Policy

Analysis of Road Safety Management Systems in Europe

The objective of this chapter is the analysis of road safety management in European countries and the identification of “good practice”. A road safety management investigation model was created, based on several “good practice” criteria. Road safety management systems have been thoroughly investigated in 14 European countries on 2010, by means of interviews with both governmental representatives and independent experts, who filled in an extensive questionnaire. A reliable and accurate picture (“profile”) was created for each country, allowing for country comparisons. Then, statistical methods were used to make rankings of the countries, and analyze the relationship between road safety management and road safety performance. The results of the analyses suggest that it is not possible to identify one single “good practice”. Nevertheless, there were several elements that emerged as “good practice” criteria. On the basis of the results, recommendations are proposed at national and European level.

1.1. Introduction

In Muhlrad *et al.* [MUH 11] a road safety management system is defined as “a complex institutional structure involving cooperating and interacting bodies, which supports the tasks and processes necessary to the prevention and reduction of road traffic injuries”. By definition, a road safety management system should meet a number of “good practice” criteria spanning the entire policy-making cycle, from agenda setting to policy formulation, adoption, implementation and evaluation and including efficient structure and smooth processes, to enable evidence-based policy-making.

Chapter written by Nicole MUHLRAD, Gilles VALLET, Ilona BUTLER, Victoria GITELMAN, Etti DOVEH, Emmanuelle DUPONT, Heike MARTENSEN, Pete THOMAS, Rachel TALBOT, Eleonora PAPADIMITRIOU, George YANNIS, Luca PERSIA, Gabriele GIUSTINIANI, Klaus MACHATA and Charlotte BAX.

Effective organization of road safety management is assumed to be one of the conditions for obtaining good road safety results at the country level [DAC 12, ELV 12]. Moreover, as road safety is becoming more and more integrated into broader scoped transport or environment policies, and given the effects of the current economic recession on road safety resources, the need for optimization of road safety management systems becomes even more pronounced.

Within the DaCoTA research project, a road safety management investigation model proposed by Muhlrاد *et al.* [MUH 11] is based on several “good practice” criteria, defined by an exhaustive literature review, to address the need for optimized road safety management systems, leading to better road safety performance in a changing environment.

The objective of this chapter is to present the analysis of a road safety management framework in European countries and the identification of “good practice” for the optimization of road safety management processes, carried out within the DaCoTA research project.

For that purpose, road safety management systems have been thoroughly investigated in 14 European countries in 2010, by interviews with governmental representatives and independent experts in each country, who filled in an extensive questionnaire on the degree to which the various road safety management systems meet the “good practice” criteria. A shorter version of the DaCoTA questionnaire has also been prepared in collaboration with the European Transport Safety Council (ETSC) and dispatched to the ETSC-PIN panel of experts. The data was then analyzed by means of both quantitative and qualitative analysis.

This chapter is structured as follows: in section 1.2, the road safety management investigation model is presented, and the data collection and handling procedures are described. In section 1.3, the results of qualitative analysis of the data are presented, while section 1.4 concerns the results of quantitative analysis. Section 1.5 presents the conclusions of the research in terms of road safety management “good practice” in Europe. Finally, section 1.6 summarizes the DaCoTA key messages and recommendations for the improvement of road safety management systems in Europe.

1.2. Methodology

1.2.1. Road safety management investigation model

The investigation model of [MUH 11] describes road safety management structures and outputs according to the policy-making cycle (agenda setting, policy

formulation, adoption, implementation and evaluation) set against the background of a typical hierarchical national government organization (Figure 1.1). The most complete RS management system, which would have been obtained for a country fulfilling all the “good practice” criteria that was identified and was used as a reference (Figure 1.2). For each country, “good practice” elements, a lack of such elements and peculiarities can be then summarized in a “diagnosis” including structures, processes, policy-making tasks and outputs according to the investigation model.

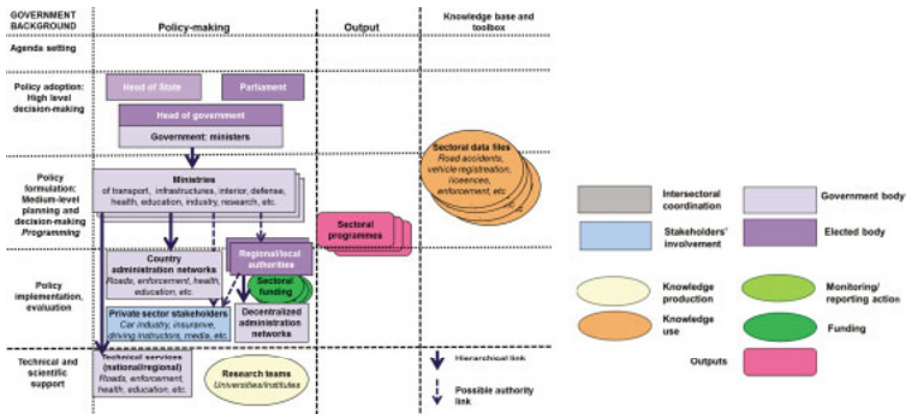


Figure 1.1. Government organization background. For a color version of the figure, see www.iste.co.uk/jacob/safety.zip

1.2.2. Data collection and handling

On the basis of the investigation model, an extensive DaCoTA questionnaire was developed, by which various road safety management systems meet the “good practice” criteria. The questions related to the five main areas of Road Safety Management:

- institutional organization, coordination and stakeholders’ involvement;
- policy formulation and adoption;
- policy implementation and funding;
- monitoring and evaluation;
- scientific support and information, capacity building.

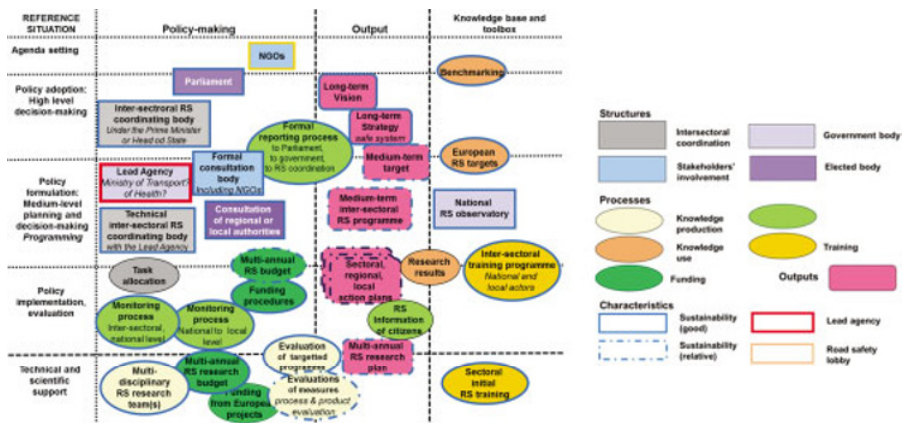


Figure 1.2. "Reference" country meeting all the "good practice" criteria.
For a color version of the figure, see www.iste.co.uk/jacob/safety.zip

The questionnaire was filled in for 14 countries. More specifically, the DaCoTA partners represented the 12 countries: Austria, Belgium, Finland, France, Greece, Israel, Italy, Latvia, the Netherlands, Poland, Spain and the United Kingdom, and were able to collect data in the native language of a further two: Ireland and Switzerland. To maximize the representativeness of the sample, questionnaires were sent by email to road safety actors in Latvia and Spain to fill in independently without an interview. However, clarifications were sought when necessary.

Two groups of road safety professionals were targeted:

- government representatives: road safety practitioners who are or have been directly involved in policy and decision making over a long enough period of time for them to have acquired wide-ranging experience in road safety;

- independent experts: road safety researchers or scientists who may contribute to policy but do not have a decision making role and could offer a non-partisan view of the Road Safety Management systems in place.

A shorter version of the DaCoTA questionnaire was been prepared in collaboration with the European Transport Safety Council (ETSC). This questionnaire includes 11 key questions similar to those of the original DaCoTA questionnaire and was dispatched to the PIN panel of the ETSC, i.e. the 30 high level national experts from ETSC network of member organizations. This gave a general overview of the Road Safety Management system in 30 countries, although in much less detail than the DaCoTA data.

The combined use of the two questionnaires allowed on the one hand the coverage of basic road safety management elements for all European countries (DaCoTA/ETSC-PIN questionnaire), and on the other hand the full in-depth analysis for a subset of European countries (DaCoTA questionnaire).

1.3. Qualitative analyses of road safety management systems in Europe

Within the qualitative analysis of the DaCoTA research project, a thorough analysis and cross-checking of the questionnaire responses and related comments was carried out, for both the governmental representatives and the independent experts, in order to draw a reliable and accurate picture or “profile” for each country, and allowing for in-depth country comparisons for selected key items. For further details, the reader is referred to Papadimitriou *et al.* [PAP 12].

1.3.1. Road safety management profiles

Country profiles of the road safety management systems in the 14 European countries were analyzed and compared to the reference “good practice” system (Figure 1.2). Road safety management structures and outputs are described according to the policy-making cycle (agenda setting, policy formulation, adoption, implementation and evaluation) and set against the background of a typical hierarchical national government organization. Because such a typical organization is not suited to managing road safety policies, which involve most government sectors, specific structures have been set up in most countries, modifying or short-circuiting the typical hierarchical administration.

For each country, these structures as well as the working processes were charted to provide a graphic picture of the road safety management situation (“country profile”), such as the one presented in Figure 1.3 for Belgium, and the identification of “good practice” elements, such as those presented in Figure 1.4 for Belgium. Focus was on the national organization and the relationships between national and regional/local structures and not on road safety management at the decentralized level, as it was agreed at an earlier stage of methodology building that this aspect could not be tackled in the timeframe of the DaCoTA project.

The thorough analysis of the country profiles, together with additional information from the DaCoTA/ETSC-PIN data, allowed for an in-depth analysis and comparison of countries, leading to several observations and conclusions. These are summarized in section 1.3.2.

1.3.2. Summary of country analyses

1.3.2.1. Institutional organization, coordination and stakeholders' involvement

A large variation was observed in the structures and processes at the higher level of road safety management. The component “Lead Agency formally appointed to take responsibility for road safety” had a higher availability level among the countries. However, different types of Lead Agencies (from strong departments of ministries, to interministerial committees and road safety councils) and with different specific roles were identified. In several cases, it is not easy to identify the “lead agency”.

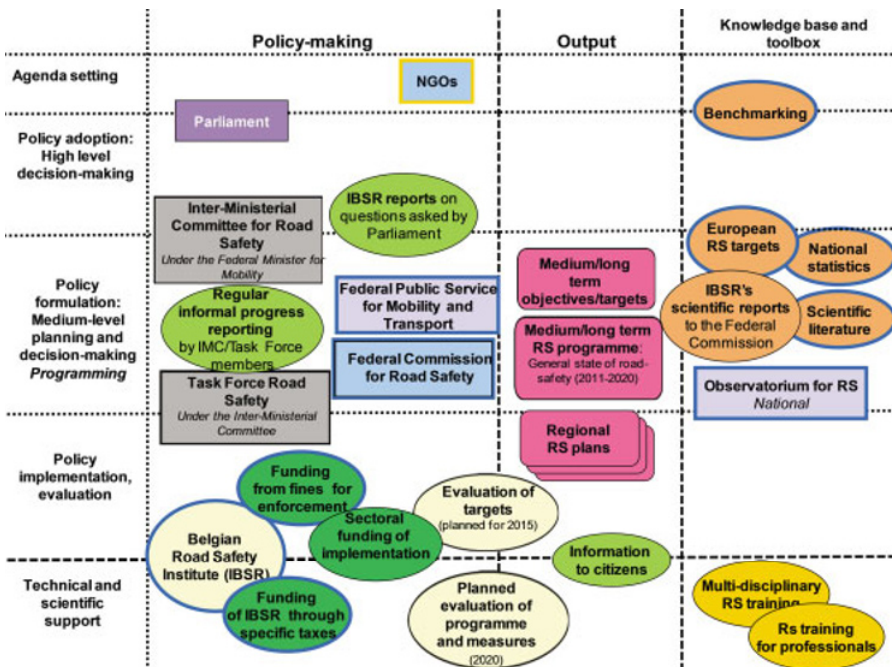


Figure 1.3. Structures, processes and outputs in Belgium, 2010. For a color version of the figure, see www.iste.co.uk/jacob/safety.zip

Although it is widely acknowledged that effective road safety management can be achieved with lead agencies of various structural and procedural forms (BLI 09), the results of DaCoTA suggest that road safety management systems based on strong departments of ministries, or that use government agencies specifically established for this purpose, with clear responsibility for the government's road safety policy, are more effective.

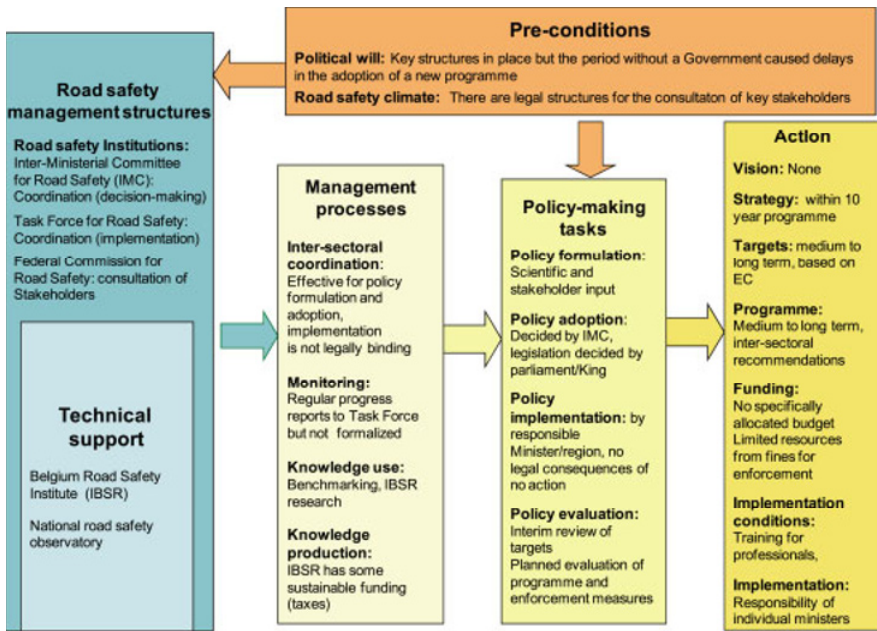


Figure 1.4. Overview of road safety management good practice elements in Belgium, 2010

The DaCoTA results clearly indicate that the establishment of a structure and process alone is not sufficient for effective road safety management. In several countries coordination and budget are the most critical links for setting the processes in motion. The effectiveness of road safety management systems can also be largely affected by the degree to which regional authorities, NGOs, stakeholders or the public at large are involved via systematic consultation at all stages of the policy-making process. Very few countries demonstrate such routines and fruitful consultation processes.

1.3.2.2. Policy formulation and adoption

Road safety policy formulation showed the largest degree of “consensus” between countries, especially with regards to the presence of a road safety strategy with specific quantitative targets for fatality reduction. Nevertheless, several inconsistencies and uncertainties are involved in the adoption of road safety programs and the participation or consultation of regional and local authorities.

Road safety visions and targets appear to be strongly influenced by either European Union proposals or road safety “leader” countries in Europe. The vast

majority of countries have adopted the EU target for 2020, as they had also adopted the previous one of 2010. “Vision Zero”, “Sustainable Safety” and “Safe Systems” are the main visions endorsed by several countries. Almost all European countries have road safety strategies and programs, with the majority boasting the ambitious EU targets.

There is a lot of inconsistency in the design of the programs, the setting of priorities and the implementation schedule. Proposals coming from regional or local authorities are hardly ever integrated into national road safety programs. The same is the case for the allocation of resources, so that the regional or local budgets are seldom ensured or even defined at all. Finally, the formal adoption of road safety strategies and programs takes place under quite different procedures in different countries – and in several countries it remains pending.

1.3.2.3. Policy implementation and funding

In general, the implementation of programs and measures appears to be the weakest component of road safety management systems in Europe, especially with regards to the establishment of formal resource allocation procedures, the allocation of funding to evaluation, the sufficiency of funds and human resources and the drafting of plans to support implementation.

The problem of providing stable economic foundations for implementing and managing road safety programs is the key to improved effectiveness and efficiency of road safety work. A decision is seldom taken to ensure the availability of a budget for road safety activities from the national budget. Moreover, the lack of information on measures implementation costs at national and international level, combined with a lack of knowledge on the methods appropriate to calculate these costs, makes the evaluation of the actual implementation expenses an estimation by itself.

Moreover, formal procedures for budget allocation to the various actors are seldom in place, especially for the regional or local authorities. As a consequence, the agency responsible for implementation has to rely on its own budget, and the implementation itself depends on the resources available in this agency as well as on the priority it assigns to road safety.

In countries with a clearly designated “lead agency”, this agency takes over the majority of program management duties, otherwise it is not always clear who is responsible for what part of the implementation. A lack of coordination at the operational level is clearly identifiable, resulting in some sectors being more efficient than others in performing the road safety interventions that they have been assigned.

1.3.2.4. Monitoring and evaluation

A satisfactory level of availability was identified with respect to “benchmarking” for monitoring progress in the road safety situation in relation to the other countries. Nevertheless, most elements related to monitoring and evaluation had a medium or lower level of availability across the countries. In the majority of cases it involves collecting information when a program ends; only a couple of countries monitor programs while they are still in progress.

Only in a few countries is the evaluation of safety measures part of the culture and routine within the road safety program, with a dedicated budget. In several countries, evaluation is very rare and adjusted to the available budget. Even when evaluation is consistently performed, it is usually limited to infrastructure and enforcement measures, or to specific behaviors targeted by specific measures. Formal efficiency assessment techniques are not always implemented. As regards the evaluation of the overall road safety program, it is mostly limited to a “checklist” of the specific measures foreseen, rather than an actual evaluation.

1.3.2.5. Scientific support and information, capacity building

In most countries, a higher than medium level of availability is observed for a number of elements related to scientific support and information, such as the use of research results for formulating road safety policies, the systematic information of citizens on the national road safety policy and interventions and their effects, and the presence of articles or programs in the media, which review, criticize or challenge current road safety policies.

Moreover, in most countries, there is at least one research institute or university department performing multi-disciplinary road safety research. While national road safety observatories exist in most countries, there is great variation in their type, role and operation. Only in a few countries are the road safety observatories a part of the lead agencies, while in most cases this role is taken over by research centers, statistical offices or the police. Capacity building and training of road safety actors is seldom a systematic procedure with a dedicated budget. A better use of the scientific capacity appears to be one of the major challenges for evidence-based road safety policy-making in the European countries.

1.4. Quantitative analyses

The quantitative analyses carried out within DaCoTA used statistical methods to identify patterns and rankings of countries, as regards both the road safety management characteristics, and the relationship between road safety management

and road safety performance. For further details, the reader is referred to Papadimitriou *et al.* [PAP 12].

1.4.1. Clustering of countries on the basis of road safety management components

Statistical clustering techniques were used to group and rank the 14 European countries on the basis of their level of availability of the various road safety management “good practice” elements, separately for each one of the five areas of the DaCoTA questionnaire (see section 1.2.2). Figure 1.5 presents, as an example, the clustering results concerning the first area of the questionnaire, namely “institutional organization”. A ranking of countries in terms of their road safety management system, per area and as a whole, was also presented.

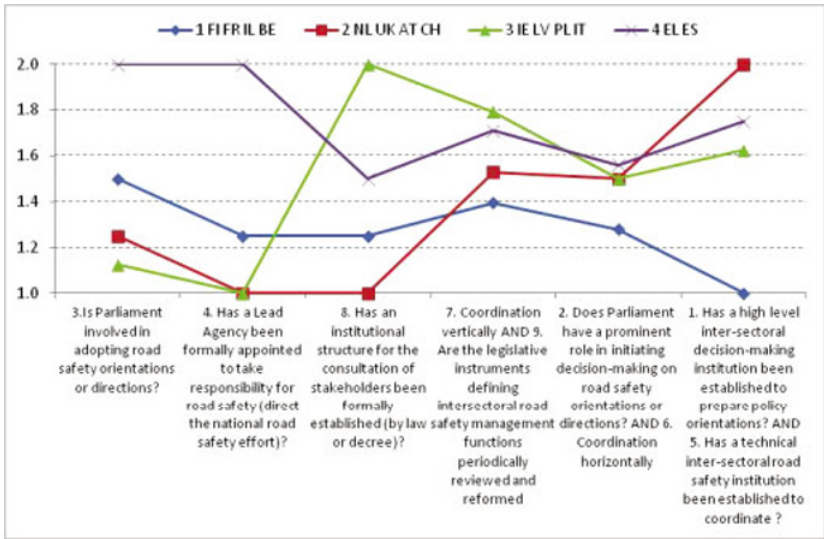


Figure 1.5. “Institutional organization”: mean values of availability of road safety management elements, by clusters of countries. For a color version of the figure, see www.iste.co.uk/jacob/safety.zip

The analyses confirmed that the complexity and variability of road safety management systems is such that the task of ranking the countries in terms of road safety management is very demanding. It was revealed that all the countries are completely different when road safety management systems are considered as a whole, making it impossible to propose a single overall ranking of countries’ road