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Abstract

The project PEPPER (Police Enforcement Policy and Programmes on European Roads) aimed to contribute to the efficiency and effectiveness of traffic law enforcement on EU roads. While the focus of the project was on traffic policing, the whole enforcement chain was examined—from policy choices about the role of police in road safety, through traffic law making, traffic police enforcement practices and the handling of driving offences by the courts. The focus of the project was on the enforcement of speeding, drink-driving and use of seat belts. With regard to these unsafe behaviours, more detailed analyses were made of the planning and implementation of their actual enforcement across member states, the potential of new technologies to support better enforcement and improved compliance, and of the conditions and means to disseminate good practices for effective traffic policing. The availability of enforcement data in Member States was surveyed and suggestions were made concerning uniform, EU-wide enforcement data collection methods and databases. Innovative technologies in Traffic Law Enforcement were described and their potentials assessed, including the applications regarding cross-border enforcement. Good practices were described concerning strategic planning and tactical deployment in traffic law enforcement as well as collection and use of enforcement data for monitoring and evaluation purposes. The knowledge of the effects of enforcement of drink driving, speeding and seat-belt use was updated by applying meta-analysis on previous evaluation studies.

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EXECUTIVE SUMMARY

In the *White paper on transport policy* the European Union has set an ambitious goal of halving the number of traffic fatalities over the period of 2000–2010. The goal was confirmed in 2003 in the *Road Safety Action Programme*. The White Paper identifies a number of principal lines of activity for achieving the target including harmonisation of penalties and promotion of new technologies to improve road safety. In 2004 the *Commission Recommendation on Enforcement in the field of Road Safety* urges Member States to adopt and implement thirteen Traffic Law Enforcement (TLE) action points. They concern, primarily, enforcement of the three key areas of non-compliance behaviours, identified in earlier EC safety policy documents, as having the largest impact on un-safety: speeding, drink-driving, and non-use of safety belts. Also cross-border enforcement and cooperation between Member States are addressed in the Recommendation.

The PEPPER (Police enforcement policy and programmes on European roads) project aimed to enhance the effectiveness and efficiency of police enforcement of road traffic, by:

- Describing and analysing the way traffic law enforcement functions in Member States and how it contributes to national road safety work. Exploring different stakeholders' views of traffic enforcement in Member States and EU.
- Developing enforcement data collection systems and databases for monitoring of the use of enforcement resources and describing the impacts on road user behaviour and road safety. Identifying the data needs of the police for strategic and tactical planning of operations. Conducting pilot studies in order to test the availability of comparable European wide traffic enforcement data.
- Exploring and analysing possibilities of advanced technology such as machine vision, positioning technologies and new wireless communication technologies in the detection of violations, traffic enforcement data transfer and communication, paying attention to cost-effectiveness and cross-border enforcement.
- Evaluating the impacts of enforcement on road user behaviour and accidents. Exploring and making recommendations for good practice in Traffic Law Enforcement, based on scientific analysis of the effects. Analysing the cost-effectiveness of various enforcement methods and targets. Developing indicators for the effectiveness of Traffic Law Enforcement.

The results of the project are briefly summarised below.

Strategic, legal, administrative and social context of Traffic Law Enforcement (TLE) in Member States

EU policies on road safety and TLE were studied by analysing official documents concerning standards, directives, recommendations, actions, statements and communications. National road safety plans and traffic policing strategies were reviewed and updated with 2006–2008 information. Top police and road safety officials were interviewed and survey data concerning TLE policy and planning issues were analysed. TLE chains across EU Member States and in relation to EU policies were analysed on the basis of a questionnaire survey. The interest was

on elements of planning, monitoring and evaluation, automated methods for violation registration, legal and administrative background, information campaigns and other driver awareness activities. Social support for Traffic Law Enforcement policies and practices within Member States was studied mainly on the basis of interviews of TLE professionals in seven countries and reanalysis of data from the SARTRE3 project. The main findings and conclusion were:

- Interviews and surveys of politicians, traffic law professionals, other stakeholders and the general public, suggest wide support for EU safety policies. There is a universal recognition that TLE has an important role in maintaining legal and safe road user behaviour, but also that it can and must be made more efficient and effective.
- Most of the practices promoted by the 2004 EC Recommendation on Enforcement – massive speeding control, automated speed enforcement, firm drink-driving control with massive random breath checks, systematic enforcement of safety belt use, cross-border enforcement, use of innovative enforcement technologies – are indeed supported by most stakeholders in all Member States.
- Massive traffic policing, as is advocated by the Recommendation, does not come cheaply. Yet, only few Member States allocated special funding for the new, or more massive, policing activities their national safety strategies declared. There are growing trends in the EU to limit the size of police forces dedicated to traffic control.
- Drink-driving legislation and enforcement practices enjoy strong support from all stakeholders, in each state. There is also support for stronger sanctions.
- Stakeholders like the idea of increased harmonization of cross-border enforcement, even as they express practical concerns about the functioning of the legal, administrative, and technological machinery needed to make it happen.
- There is less agreement, within EU institutions and among stakeholders in Member States, about the legitimacy, feasibility, practicality or desirability, of having a top-down, EU mandated TLE policy that goes into specific tactical issues of *how to do traffic policing*.
- Police forces have internal operational guidelines for tactical deployment of personnel, vehicles and equipment for traffic policing tasks. The deployment plan itself is usually considered a local matter rather than that of a national enforcement plan.
- Some states have started instituting systematic collection of traffic and road user behaviour measures as well as performance indicators for assessing the extent and efficiency of traffic police activity. Such measures are virtually non-existent for the other elements of the enforcement chain, particularly legislative work, follow-up on citations and the courts.
- Most traffic law systems in EU countries are a mix of criminal and administrative law. The nature of the legal system, however, does not seem a determining factor in the level of road safety in the country.
- Institutional barriers within the EU, and legal issues regarding EU versus Member States' privileges complicate the definition of EU policy instruments regarding road safety and Traffic Law Enforcement.

- In many of the EU states there are institutional barriers between ministries, between central and local authorities, between various police forces, which impede adoption of a coherent new Traffic Law Enforcement policy and its efficient implementation.
- Police forces are generally interested in adopting new enforcement practices and new technologies for traffic policing. However, the adoption is rarely just a technical issue. It requires changes in strategic level thinking, adaptation of legal systems and modifying management practices.
- The evidence seems compelling that massive speed control and continuous drink-driving control can have a decisive role in bringing down road fatalities substantially and relatively quickly.
- Successful upgrade of a TLE system and general safety management requires the prior availability of institutions capable of handling the upgrading and successfully working out cooperation mechanisms between the many institutions.

Enforcement data collection system and associated pilots

The data needs described in the EC Recommendation on Enforcement were compared to the current state-of-the-art on available data in the Member States. The relevant data concerning each link in the enforcement chain and the results in terms of enforcement performance indicators were selected. Pilot studies of data collection system were organised in six Member States in order to clarify which variables can actually be used for monitoring the efficiency of the enforcement chain and to evaluate the enforcement performance indicators with regard to behaviour, accidents and fatalities. The focus was in areas speeding, drink-driving and use of seat belts. Common templates were used for gathering enforcement data from different countries for different data types. Finally, a conceptual model for the European traffic law monitoring database was outlined, capable of handling data concerning a) actors related to enforcement in each country and their roles, b) national enforcement campaigns, c) key actors' opinion on enforcement measures, d) traffic enforcement technologies and aids, and e) cross-border enforcement rules and best practices. The main findings and conclusion were:

- A conceptual model for European TLE database consists of three main elements of the data chain: input, system and output, which are closely interconnected. On the output side the focus is on presenting well-defined, structured data, typically originating from a number of different sources.
- The database should be capable of handling differences in legislation, sanctions and the organisation of police enforcement forces between Member States.
- On the input side the focus lies on how to support data collection on a single question and single user level, and input data is typically more disaggregated than the output data. The system in-between takes care of the storage and modification of data so that the desired links between input and output can be realised.
- Regarding output from the envisaged database, the data listed in the EC Recommendation on Enforcement would probably fulfil most needs. A survey of the needs of national and regional authorities and other (research) organisations should be conducted to make sure that the database would be useful to all relevant needs.

- Input to the database should contain quantitative information on planned and actual enforcement activities e.g. by enforcement target and method, the number of checked vehicles and the number of detected violations and issued sanctions.
- A survey in four Member States revealed there are large variations between countries in the availability of enforcement data, and that in general only little information is available. Data either does not exist or are considered confidential. Furthermore, the data have to be collected from several sources and are often stored in different formats and media. State-wide data about the detailed police deployment plans regarding enforcement of speeding, drink-driving and safety belt use are simply not available in any state. The same holds true for the data about actual police deployment, which could be very different from plans.
- For the evaluation of the effects of enforcement and other scientific needs, it is essential that data from the database can be extracted also on a disaggregate level.

Innovative technologies and approaches for improving compliance with traffic laws

Innovative technologies and approaches for improving traffic law compliance were identified and described mainly on the basis of literature review and a review of completed and ongoing research projects in the field. The efficiency of existing enforcement methods and implications of innovative technologies were evaluated with respect to offences that are perceived as highly involved in causing accidents, such as speeding, drink-driving, and the use of restraint systems. The technologies were categorised as active (of repressive and punitive nature) or passive (self-regulation). Approaches and implications of new technologies for European cross-border traffic enforcement were described. A conceptual model for the deployment of positioning and location technologies for the needs of traffic surveillance and enforcement was outlined. The main findings and conclusion were:

- Enhanced enforcement could reduce road accidents fatalities by approximately one third. This potential can be realized with the help of innovative active and passive enforcement systems and technology.
- Legal and administrative barriers for efficient and effective implementation of innovative enforcement systems should be removed. These barriers include technical (lack of an EU type approval mechanism), institutional (who will be the agencies responsible for implementation, operation, updating and maintenance) and legal barriers (caused by privacy issues insufficiently covered in national law or restricted by national law, e.g. driver vs. owner/keeper responsibility). Such barriers should be addressed and removed, starting at and being pushed from the EU policy level and lawgiving chain, down to all Member States. Member States should address this as well, and cooperation on this should be pursued with the European Commission, making it a really joint effort.
- Section speed control, where speeding vehicles on a stretch of road are automatically detected, can be regarded as one of the most effective enforcement systems, as it can reduce the proportion of speeding vehicles to less than 1%. If implemented generically in all Member States, the number of traffic accidents that are due to speeding could be significantly reduced. Section speed control not only reduces accidents but it has positive effects on traffic flow, congestion, and on air quality and noise.
- Alcolock in a car prevents persons whose blood-alcohol concentration (BAC) is above the legal limit, from driving. Alcolocks prevent recidivism on drink-driving and reduce

frequency of violations and alcohol-related accidents. Possible detrimental effects are fraud (e.g. driver makes someone else blow into the alcolock) and costs. High costs can prevent people from installing the alcolock. In some countries legal obstacles can prevent the implementation of alcolocks. The idea of Alcolocks was acceptable to stakeholders who have had some experience with them, but met with scepticism by others.

- Implementation of automated seat belt detection system, based on digital camera images, could raise the intensity of seat belt enforcement to a new level, and increase wearing rates. According to the pilot study it seems that the detection success of an automatic system can be very close to the situation of visual detection. Privacy issues might be an obstacle for effective use, as in the case of automatic speed enforcement.
- Regarding passive enforcement, intelligent speed adaptation (ISA) also has huge potential in reducing speeding and accidents. It is acceptable to a majority of drivers who had experience with it. There are some obstacles, however, that have to be solved before the system can be implemented on a large scale: costs of in-car and infrastructure equipment, accurate speed limit databases are not widespread, and pilot studies have demonstrated confusion because speed limits vary as a consequence of road maintenance and temporal work zones.
- Positioning technologies can be widely applied in active and passive enforcement, e.g. speed enforcement and parking area control. In such surveillance and enforcement systems vehicles are identified on the basis of their licence plates or specific electronic identification tags, and information concerning vehicles and their location (sometimes also its travelling direction and speed) are transmitted to the control centre, e.g. by employing GPRS or UMTS technology. Ticket or fees are issued automatically.
- Regarding cross-border enforcement, a common language-independent system for exchange of information regarding vehicles, owners, drivers and infringements need to be established, as suggested and tested in the VERA2 and VERA3 projects. Furthermore, the laws regarding the execution of financial penalties for traffic violations committed in another Member State need to be synchronised with the Framework Decision on the mutual recognition of financial penalties.

Good Practices in Traffic Enforcement

An overview of good practices in strategic planning and tactical deployment of TLE was provided by means of a questionnaire survey in 12 countries and a literature review. Meta-analysis of previous studies concerning the effects of enforcement of speeding, drink-driving and seat belt use on accidents were conducted. The impacts of zero BAC limit on road safety in Hungary, Czech Republic, Slovakia and Croatia were evaluated. Good practices in monitoring and evaluating the impacts of TLE were described, concerning especially on speeding, drink-driving and seat belt use. The focus was in describing the data that ideally would need to be collected to allow for monitoring and evaluating the impact of TLE. A practical method for predicting the effects of enforcement actions was developed its use demonstrated by examples. Data about current practices in TLE and related issues was collected in six Member States and organised into a database. The main findings and conclusion were:

- There are big differences between Member States in strategic planning and tactical deployment of TLE. This concerns as well general planning principles as specific planning

and deployment of the three targeted enforcement areas: speeding, alcohol and seat belts. Identified good practices of strategic planning included e.g. integration of enforcement, education and public campaigns in drink-driving enforcement, and extensive use of speed cameras, implementation of section controls systems and low tolerance threshold in speed enforcement. Good practices concerning tactical deployment included among other things random breath testing, evidential breath testing, and black spot surveillance of speeds.

- Speed enforcement usually reduces accidents but the effect depends on enforcement method. Visible, fixed speed cameras reduce the number of accidents by 34% (95% confidence interval – 25; –42%). The effects of mobile patrolling and mobile/hidden speed cameras are negligible. For stationary, manual and visible speed enforcement, and for composite methods, there are strong tendencies of accident-reducing effects, however insignificant at the 5%-level. In general, the effects of speed enforcement increase when enforcement is visible and connected to local publicity. The effects are larger for severe accidents.
- Patrolling has a significant effect on drink-driving accidents by -8% (-12; -3). The effect of alcohol checkpoints is somewhat stronger by a reduction of -15% (-18; -11). The effect varies depending on the country of the study and on study design. Effects were larger when enforcement was connected to publicity.
- Seat belt enforcement increases wearing rates by 21% during enforcement and by 15% in the period after enforcement has ended. There was no difference between the effects on drivers and on front seat passengers. The effect was larger when enforcement was conducted without signposting and when it was connected to public information.
- The results concerning the effectiveness of zero BAC limit (in Hungary, the Czech Republic, Slovakia and Croatia) on accidents involving drink-driving compared to countries with higher BAC limit were inconclusive. It seems that historical and social context and the level of drink-driving enforcement are more important than the legal BAC limit.
- A set of enforcement performance indicators (EPI) describing actual enforcement for monitoring and evaluating purposes was developed, and a system for the collection and storing of EPI data was outlined. Similarly, a set of safety performance indicators (SPI) for the evaluation of the effects of enforcement and respective data collection system were outlined.
- A practical, easy-to-use and transparent method for the prediction of the effects of enforcement on road safety was developed consisting of two main stages: the effect of enforcement on road user behaviour and the effect of the predicted change in behaviour on accidents.
- A CLEOPATRA database was created containing information on police forces, police operations and police enforcement related research in six Member States. The focus was on the enforcement of speeding, drink-driving and seat belt use. Most of the data is publicly available on-line at the TISPOL website www.tispol.org.

Dissemination

All PEPPER Deliverables and a number of Working papers are available at the website www.pepper-eu.org. During the project results were disseminated in the seminars in Brussels in April 2007, in Madrid in November 2007 and in Prague in June 2008. Four Newsletters were published and distributed via email to more than 100 User Group members. Dissemination material has also been produced, in terms of leaflets and posters and a number of papers and other dissemination actions have been undertaken by the Consortium members throughout the duration of the project.

List of abbreviations

ACC	Adaptive cruise control
ADAS	Advanced driver assistance system
BAIID	Breath alcohol ignition interlock device
BAC	Blood-alcohol concentration
CALM	Continuous air-interface long and medium range technologies
CARE	Community database on road accidents
COPEN	Framework decision on the mutual recognition of financial penalties
DB	Database
DCS	Data collection system
DUI	Driving under the influence (of alcohol)
EC	European Commission
ECMT	European Conference of the Ministers of Transport
EDES	Enforcement data exchange system
EPI	Enforcement Performance Indicator
ETSC	European Transport Safety Council
EU	European Union
EuroNCAP	European New Car Assessment Programme
EUROSTAT	Statistical Office of the European Communities
FD	Framework decision
FMEA	Failure mode and effects analysis
GNSS/CN	Global navigation satellite system/Cellular network
GPS	Global positioning system
GPRS	General packet radio service
HQ	Headquarter
ID	Identification
IRTAD	International Road Traffic and Accident Database

ISA	Intelligent speed adaptation
IT	Information technology
ITS	Intelligent transport systems and services
MID	Measuring Instruments Directive
MI-DIMES	Annex to MID for type-approval of digital imaging systems (draft)
MP	Member of Parliament
NEP	National enforcement plan
NRSP	National Road Safety Plan
SPI	Safety Performance Indicator
SRCS	Self regulation compliance system
STEP	Selective Traffic Enforcement Program
TLE	Traffic Law Enforcement
UK	United Kingdom
UMTS	Universal mobile telephone system
UN	United Nations
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
Wi-Fi	Trade name for a popular wireless technology
WP	Work Package or Working Paper

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1. INTRODUCTION

The European Union set in the White paper on transport policy an ambitious goal of halving the number of traffic fatalities over the period of 2000–2010 (European Commission, 2001). The goal was confirmed in 2003 in the Road Safety Action Programme (European Commission, 2003). When applied to the 25 Member States this means that the number of road accident fatalities in 2010 should not exceed 25 000. However, concluding from the progress so far it does not seem like the target will be reached (Figure 1).

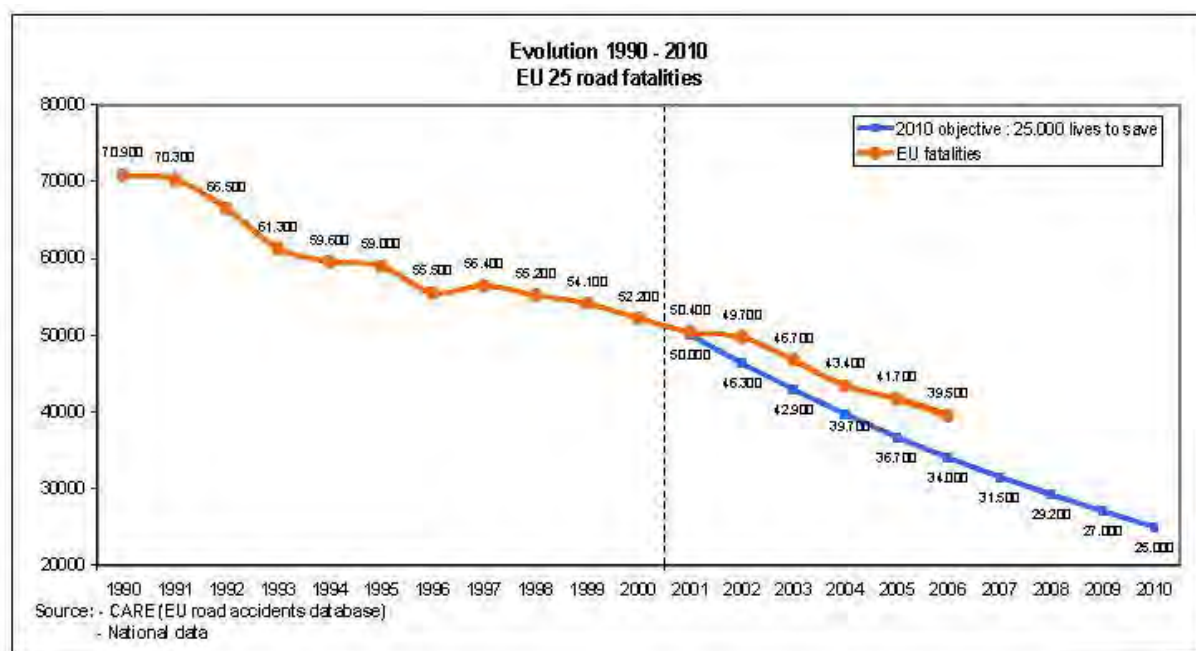


Figure 1. Road accident fatalities in the EU.

All in all, to get road safety development back to the intended track, new road safety measures need to be employed and old effective measures must be used more extensively. One of the key areas then is Traffic Law Enforcement, where there still is lots of unused safety potential. It has been estimated that approximately one third of road fatalities could be prevented by increased enforcement, and the net benefit to the society would be 37 billion euro or 0.44% of gross national product (ICF 2003, ETSC 2006). More specifically, the increased enforcement should be targeted to speeding, drink-driving and non-use of seat belts. These priority areas were recognised already in the GADGET project (Mäkinen et al. 1999), and further elaborated in the ESCAPE project which addressed the following issues: the extent of non-compliance with traffic laws and its contribution to accidents; how enforcement is organised and carried out in practice in EU countries; Traffic Law Enforcement needs, issues and constraints, old and new; the potential for new approaches, technologies and tools to improve compliance through more efficient enforcement (Mäkinen et al. 2003).

In everyday language enforcement usually means *police enforcement*, the actual work of detecting a traffic law violation, apprehending the offender, and securing the evidence needed for his prosecution. This is, however, only a part of the wider concept of *Traffic Law Enforcement*, which covers the entire enforcement chain, including the decision making

process (where and when to enforce), the actual enforcement in situ, the administrative and legal handling after infringement, up to the ways and means to follow up the persons that infringed certain rules. Consequently, the effectiveness of police enforcement depends on how the police collaborate with the other parties in the Traffic Law Enforcement chain (European Road Safety Observatory 2008).

The effectiveness of police enforcement is believed to depend primarily on how it succeeds in increasing road users' subjective risk of apprehension (so called *general deterrence*). This subjective risk of apprehension, and the effectiveness of police enforcement, increases if it is (Goldenbeld 1995, European Road Safety Observatory 2008):

- accompanied by publicity;
- unpredictable and difficult to avoid;
- a mix of highly visible and less visible activities;
- primarily focused on times and locations with high violation (maximum feedback to potential offenders) and
- continued over a longer period of time.

The European Commission Recommendation on Enforcement in the field of road safety (2004) has encouraged Member States to adopt best practice enforcement measures concerning speeding, drink-driving and non-use of seat belts. According to the recent ETSC report more and more countries are introducing automated speed enforcement and random breath testing. But even though many countries have improved their enforcement practices, there is still space for improvement even in the best-performing countries, especially in the enforcement of seat belt use (European Transport Safety Council 2006).

According to the SUPREME project, which aimed to identify best practice road safety measures in EU countries, the most successful enforcement measures concerned automatic speed enforcement, stationary speed cameras and section speed control. Other good examples dealt with random breath testing, targeted seat belt enforcement and penalty point system. (European Commission 2007)

In Traffic Law Enforcement chain the detection of infringements and issuing of sanctions on the spot is the most visible part to road users. From the viewpoint of the overall effectiveness of enforcement, the most problematic parts, however, are before and after the visible enforcement on the road: the legal framework; the decisions concerning what to enforce, how, where and when; and the follow-up of detected infringements. The effectiveness and efficiency of Traffic Law Enforcement depends more on the fluency of the handling of detected infringements than the capacity to detect violations in traffic. A key question then is whether it is necessary to identify the driver or can the owner of the vehicle be held responsible. Automated issuing of sanctions, which can significantly increase the capacity of automated speed enforcement, is only possible if the registered owner or keeper of the vehicle can be held responsible.

An important issue in enforcement is the equal treatment of road users irrespectively of their nationality. Even though the situation is not entirely satisfactory yet, significant progress has been made recently in the VERA and CAPTIVE projects, to ensure that penalties for traffic

law offences can be enforced across the borders of European Union Member States (see VERA website: www.vera3.eu). Based on the draft Directive on cross-border enforcement produced by the VERA projects, the European Commission launched in February 2008 a new initiative to implement cross-border enforcement of traffic laws. The new approach consists of a mix of the original cross-border Directive and the Recommendation on Traffic Law Enforcement mentioned before. Originally it was envisaged that the latter one was to be transformed into a Directive but the Commission has now combined it with the cross-border Directive on cross-border enforcement in order to avoid the problem that blocked the first attempt based on the VERA Directive solely. This blockage was caused by the fact that discussion emerged on where the responsibility for cross-border traffic enforcement belongs, to the 1st (traffic/transport) or the 3rd pillar (justice).

In principle the three most important forms of police enforcement could be replaced by technical devices:

- in-vehicle speed-limiters would prevent drivers from exceeding the prevailing speed limit;
- alcohol interlocks would prevent driving under the influence of alcohol;
- seat belt interlocks would prevent driving when seat belts are not engaged.

It seems, however, that political and public support and acceptance of such devices still need to increase before such “self-enforcing” devices can be made mandatory in all vehicles. Therefore, police enforcement will remain, for the time being, a crucial means to maintain compliance with the three important target behaviours.

The identification and selection of ‘good practices’ in Traffic Law Enforcement rely on results of studies evaluating the effects of enforcement on compliance and on road safety. Meta-analysis of previous research shows that enforcement can significantly improve safety and that the effects vary by type and target of enforcement (Elvik & Vaa 2004). Current knowledge of the effects of enforcement on road safety could be improved by systematic integration of recent studies.

1.1 Objectives

The project PEPPER aimed to contribute to the improvement of road safety in EU Member States by promoting effective police enforcement. Here police enforcement is seen in a wider road safety and social context. The approach encompasses issues like the role of enforcement in national road safety plans, strategic planning and tactical deployment, legal and administrative handling and follow-up of infringements, the impacts of different kinds of enforcement on safety, the availability and need of enforcement data as well as social and political acceptance of enforcement. More specifically, PEPPER aimed to

- Describe and analyse the way Traffic Law Enforcement functions in Member States and how it contributes to national road safety work.
- Explore different stakeholders' views of traffic enforcement in Member States and EU.
- Develop enforcement data collection systems and databases for monitoring of the use of enforcement resources and describing the impacts on road user behaviour and road safety. Identify the data needs of the police for strategic and tactical planning of operations.

Conduct pilot studies in order to test the availability of comparable European wide traffic enforcement data.

- Explore and analyse possibilities of advanced technology such as machine vision, positioning technologies and new wireless technologies in the detection of violations, traffic enforcement data transfer and communication, paying attention to cost-effectiveness and cross-border enforcement.
- Evaluate the impacts of enforcement on road user behaviour and accidents. Explore and make recommendations for good practices in Traffic Law Enforcement, based on scientific analysis of the effects. Analyse the cost-effectiveness of various enforcement methods. Develop indicators for the effectiveness of Traffic Law Enforcement.

The objectives are described in more detail in chapters 4 to 7, in sections describing the results of the project.

1.2 Report structure

In the following chapters project consortium is described in Chapter 2 and project structure in Chapter 3. The results of the project are presented in Chapters 4 to 7 corresponding to workpackages 1 to 4 of the project. Dissemination activities are described in Chapter 8. Conclusions are summarised in Chapter 9. References to non-PEPPER sources are listed in Chapter 10.

The authors of the different chapter of this report are (main author mentioned first followed by contributors):

Chapter 1–3	Veli-Pekka Kallberg
Chapter 4	David Zaidel
Chapter 5	Anu Siren
Chapter 6	Jan Malenstein
Chapter 7	Truls Vaa, Alena Erke, Ingrid van Schagen, Veli-Pekka Kallberg, Cor Kuijten
Chapter 8	Evangelia Gaitanidou
Chapter 9	Veli-Pekka Kallberg
Other parts	Veli-Pekka Kallberg

The structure of this report was designed by Veli-Pekka Kallberg, who was also responsible for the integration of the different parts. David Zaidel's comments on the final drafts contributed significantly to the finishing touches.

All PEPPER Deliverables and Working Papers are listed in Annex 1 and their abstracts can be found in Annex 2. In the text references to PEPPER Deliverables are in the format PEPPER Dx, where x is the number of the Deliverable, and references to Working Papers are in the format PEPPER Wy, where y is the number of the Working paper.

2. PROJECT CONSORTIUM

The PEPPER project was realised by the consortium described in Table 1.

Table 1. PEPPER consortium and partners' contribution to different work packages.

Institute	Role	Key persons
1. VTT (Technical Research Centre of Finland) Finland	Coordinator, partner in WPs 3, 4 and 5	Veli-Pekka Kallberg Virpi Anttila Mikko Poutanen Kimmo Kauvo
2. 4Sight (4Sight Ergonomics and Safety) Israel	Leader of WP1, partner in WPs 3 and 4	David Zaidel
3. IBSR/BIVV (Belgian Road Safety Institute) Belgium	Partner in WP 2	Lars Akkermans
4. KLPD (Netherlands's National Police Agency) the Netherlands	Leader of WP3, partner in WPs 1 and 4	Jan Malenstein Cor Kuijten Ad Hellemons
5. bfu (Swiss Council for Accident Prevention) Switzerland	Partner in WPs 1 and 4	Uwe Evert Steve Vaucher
6. CErTH/HIT (Hellenic Institute of Transport) Greece	Leader of WP5, partner in WPs 1, 2, 3 and 4	Lila Gaitanidou Villy Portouli Vassilis Vavakos Panos Papaioannou Evangelos Bekiaris Pavlos Spanidis
7. BASt (Federal Highway Research Institute) Germany	Partner in WP 4	Heiko Peters Kai Assing
8. CDV (Transport Research Centre) Czech Republic	Partner in WPs 1, 2 and 4	Vlasta Rehnova Pavlina Filemonova-Rocakova Pavlina Skladana
9. DTU (former DTF, Technical University of Denmark) Denmark	Leader of WP2, partner in WPs 1 and 4.	Anu Siren Ivanka Orozova-Bekkevold Lotte Larsen Inger Marie Bernhoft Annette Meng Tove Hels Carsten Jensen
10. IBDiM (Road and Bridge Research Institute) Poland	Partner in WPs 1, 3 and 4	Jacek Malasek Barbara Krol
11. INRETS (Institut National de REcherché sur les Transport et leur Sécurité) France	Partner in WPs 1 and 3	Jean Pierre Cauzard Marie Chantal Jayet

Institute	Role	Key persons
12. KfV (Former KuSS, Kuratorium für Verkehrssicherheit) Austria	Partner in WPs 2 and 3	Michael Gatscha Cornelia Nussbaumer Daniela Kunzel
13. SWOV (Institute for Road Safety Research) the Netherlands	Partner in WP 4	Ingrid van Schagen Charles Goldenbeld
14. TØI (Institute of Transport Economics) Norway	Leader of WP4, partner in WP 3	Truls Vaa Alena Erke Tonje Grunnan Beate Elvebakk
15. TRL (Transport Research Laboratory) United Kingdom	Partner in WPs 1, 3 and 4	Allan Quimby
16. UPM (Universidad Politécnica de Madrid) Spain	Partner in WPs 2, 3 and 4	Maria José Martínez Jorge Alfonso Kurano José Manuel Menéndez
17. VTI (Swedish National Road and Transport Research Institute) Sweden	Partner in WPs 1, 2 and 3	Sonja Forward Jörgen Larsson Magnus Hjalmdal Peter Loukopoulos
18. ETSC (European Transport Safety Council) Belgium	Partner in WP 5	Timmo Janizek Ellen Townsend

3. PROJECT STRUCTURE

PEPPER work packages and tasks within work packages are described in Figures 3 and 4.

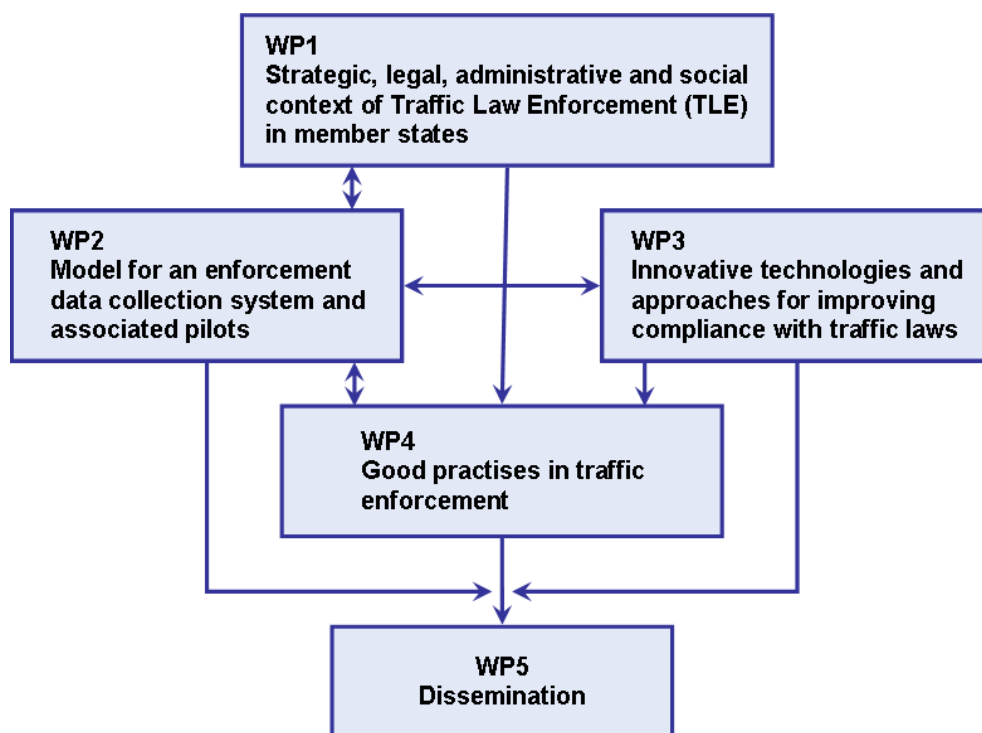


Figure 2. PEPPER work packages and their interdependencies.

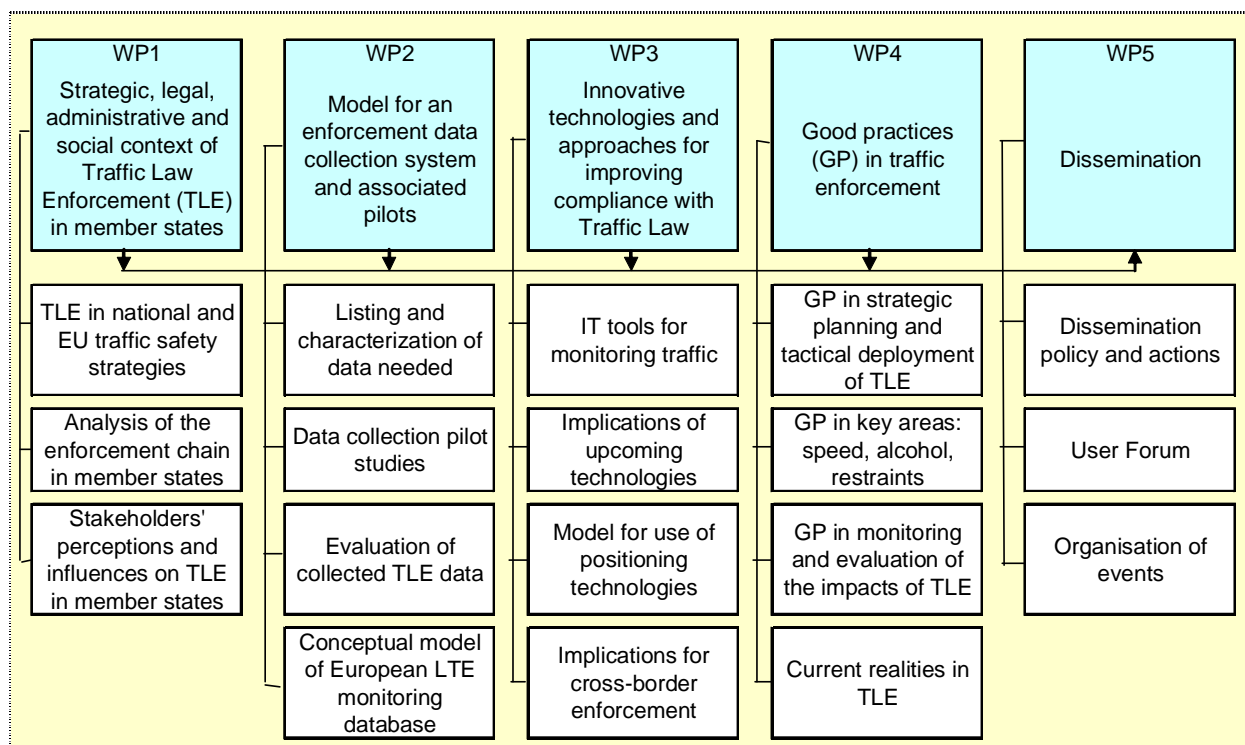


Figure 3. Tasks within PEPPER work packages.

4. STRATEGIC, LEGAL, ADMINISTRATIVE AND SOCIAL CONTEXT OF TRAFFIC LAW ENFORCEMENT

The results presented in this chapter are based on PEPPER deliverables 2, 6 and 7.

4.1 *Traffic Law Enforcement at EU level and in National Road Safety Policies*

4.1.1 The role of enforcement in EU safety policy

The *White Paper on European Transport Policy* (European Commission, 2001) posted the safety goal of halving the number of road accident victims (fatalities) in the European Union by the year 2010. The responsibility for achieving this ambitious target is to be shared by all stakeholders in the transport system and by all Member States.

The *European Road Safety Action Programme* (European Commission, 2003) identified four major areas of actions for making progress towards the above mentioned goal:

- Induce road users to improve their behaviour;
- make vehicles safer;
- make professional transport safer; and
- improve road infrastructure.

The EU, Member States, regional and local authorities, industry, transport companies and private users – all are expected to initiate or support relevant actions in those areas, so that the common goal is achieved.

The *Road Safety Action Programme* identified four major policy instruments for influencing road user behaviour, the first item in the action programme:

- Active Traffic Law Enforcement by the official police agencies in each Member State, operating with harmonized Traffic Laws and practices, and cooperating with each other;
- Better control of driving licenses;
- Better control of professional drivers and;
- Public persuasion, by media information and campaigns, to enhance compliance.

Thus Traffic Law Enforcement had become a major policy instrument with DG-TREN Directorate in the EC, formulating the Recommendation on Enforcement (European Commission, 2004) and, more recently, the proposed Directive on Cross-border Enforcement (Commission, 2008).

The *Commission Recommendation on Enforcement in the field of Road Safety* (European Commission, 2003, 2004) urges Member States to adopt and implement thirteen TLE action points. They concern, primarily, enforcement of the three non-compliance behaviours,

identified in earlier EC safety policy documents, as having the largest impact on un-safety: *speeding, drink-driving, and non-use of safety belts*. Also cross-border enforcement and cooperation between Member States are addressed in the Recommendation.

The preamble of the recommendations, the action points and the more detailed suggestions listed in the Annex, address in fact a number of topics, with a mix of strategic, tactical and procedural / management recommendations (although this classification is not used in the Recommendation).

Figure 4 is the author's interpretation of the overall logic of the Recommendation. It shows the prescribed model of a TLE system in any state, and how it should be influenced by EU safety policies. It is an idealised and simplified model, of course.

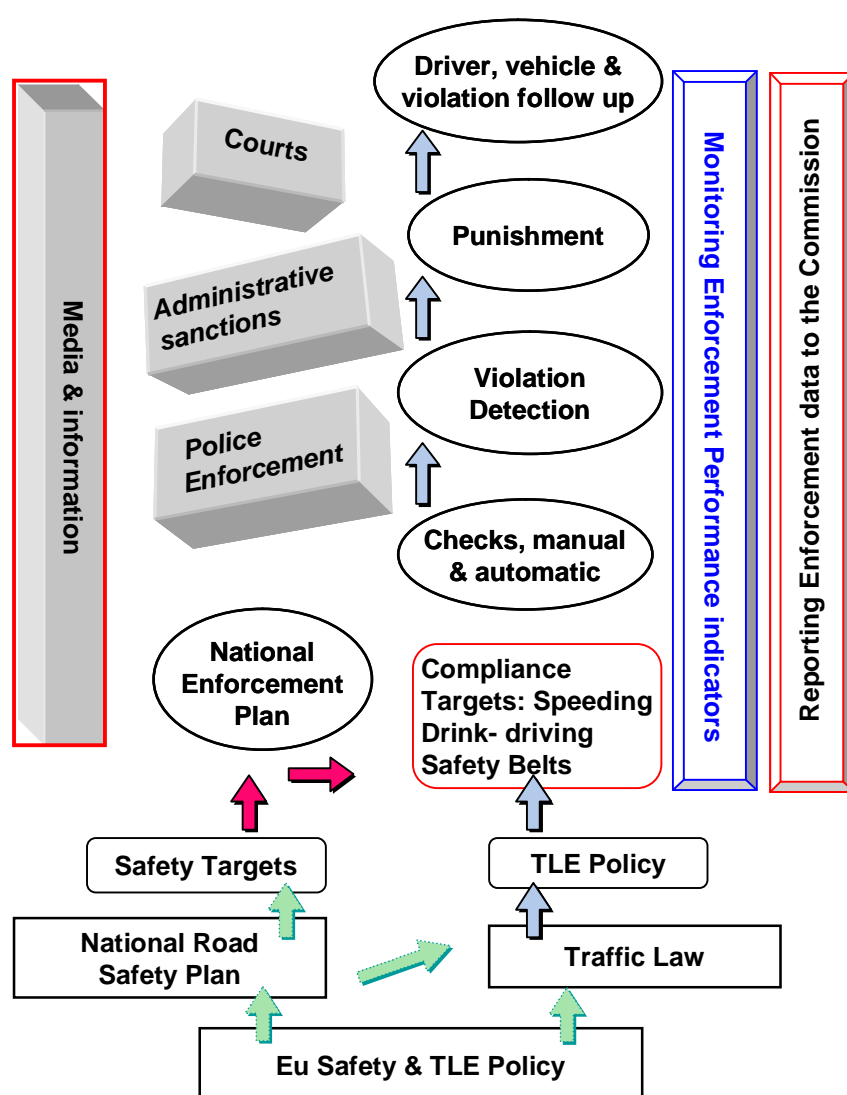


Figure 4. An overview of EU policy about TLE.

The model has a Top-Down view (down-up in the figure) of TLE policy and practice. EU level Safety policy (the White Paper and Action Programme) generate EU level TLE policy

(the Recommendation on Enforcement), which in turn influences National Road Safety Plan and a National Traffic Law.

On a strategic, policy level (green arrows) it is anticipated that states adopt an explicit *National Road Safety Policy* or plan (NRSP), which includes an ambitious accident reduction *target* similar to that expressed by the Commission (-50% fatalities by year 2010).

It is also expected that states share the EC view that police enforcement is the major policy instrument to achieve the safety target. Many documents by the EC and by other organizations (e.g. ETSC) state that in the short term traffic policing is the quickest and most effective way of reducing fatalities substantially (e.g. *Respecting the Rules*, EC Nov. 2006).

Furthermore, it is expected that states agree that *massive enforcement of speeding, drink-driving and of non-use of seat belts* are the most effective ways of influencing road-user behaviour and of reducing road fatalities. The Recommendation is very specific about the *manner* of enforcing each of the above target behaviours: *Use automated speed enforcement equipment; Apply massive Random Breath Testing; Use and legally accept the results of evidential breathalyzer devices; Apply large scale dedicated controls for seat belts use.*

The other strategy level suggestions (not shown in the figure) concern the issues of across-border traffic. The Recommendation expects the states to work towards *harmonization of TLE regulations and practices*, and develop *international cooperation mechanisms* for handling non-resident violations. A Directive on cross-border enforcement was recently proposed by the EC (European Commission, 2008.)

The Recommendation asks for a *National Enforcement Plan*, which is typically a strategic type document, but here it is expected to also include very specific details of police deployment (*how, how often, how long, at what type of locations, with which equipment, etc.*) in controlling speed, drink-driving and safety belt use.

Also Media & Information (red bar on the left) are, in this context, a tactical element. Information serves to amplify individual or local impacts of all enforcement functions in the enforcement chain. Suggestions how to use media and information are included in the text of the Recommendation.

The group of *management and procedural recommendations* address two requirements. The first is about the necessity of managing the process of traffic policing, or the '*Enforcement chain*' efficiently (blue arrows & bar).

The main actors in the Enforcement Chain are the legal system, the Police, various administrative bodies (e.g. licensing authorities) and the courts. On the basis of Traffic Law and NRSP it is expected that a *TLE Policy* will be formulated. Police and the other actors in the 'chain' will engage in patrolling the roads (General Surveillance, not shown), in active traffic violations detection, and in following through the administrative and legal consequences of the citations.

The Recommendation asks for *efficient processing of citations*. It suggests that adopting a more administrative (compared to criminal) approach to the sanctioning process would facilitate the process. Efficient management of citations also requires good record keeping of the process.

This is represented by ‘Monitoring Enforcement Performance Indicators’ in Figure 4 (blue bar).

Evaluation of traffic policing also requires systematic monitoring of traffic behaviour and of enforcement activities. Deliverable 4a of PEPPER addresses the issues of monitoring and evaluation in detail and offers a ‘good practice’ methodology for doing it

Reporting national enforcement data to the Commission (red bar in Figure 4) is a procedural requirement, which could be viewed as a Top Management or legal control mechanism. However, even voluntary readiness by a State to follow this requirement, might facilitate the creation of mechanisms and tools needed to implement it.

4.1.2 The role of Traffic Enforcement in National Road Safety policies

Series of interviews with officials in selected countries, survey questionnaires with officials in others countries and review of official documents and of earlier research reports, provided information about the contents and process of formulating Road safety and TLE policies in EU countries. Our focus was on how TLE was represented in Road Safety Plans, to what extent state plans and policies reflected EU policies on Road Safety and TLE, and what where the differences between them.

During the last 10 years just about every country in the EU (including new Member States) has published a National Road Safety Plan with a “vision”, a “target” and a varied mix of “safety problems”, “safety priorities”, “safety measures”, “safety actions” and, sometimes, “new initiatives”.

Just about all states adopted the concept of accident reduction targets, and the chosen figure is similar to EC target of about -50% fatality reduction, from reference years 2001 to 2010, or thereabout. By and large, the plans do not specify separate fatality reduction targets for TLE activities or for other action areas.

TLE is always represented, in all countries, in the committees preparing a NRSP, by experts from ministry of police and traffic police, ministry of justice, ministry of interior and other agencies responsible for legal or administrative sanctions.

States have assimilated the EC position about the centrality of enforcing speeding, drink-driving and non-use of belts (and helmets) in the strategy for reducing road fatalities.

While TLE is a significant element in most NRSPs, not many countries reported having a National Traffic Law Enforcement strategy or program derived from the National Road Safety Plan, in a sense of new vision, priorities, directions and methods of enforcement. The new French Enforcement strategy of 2002 was a unique case in this respect.

NRSPs do not usually address the methods of police operations, with the exception of reference to massive automatic speed enforcement, or random breath tests. Police are expected to deal with any non-compliance behaviour relevant to a given safety issue, using their usual methods, perhaps “more of it”.

Police forces (especially those dedicated to traffic work) usually have internal operational guidelines for tactical deployment of personnel, vehicles and equipment for traffic policing tasks. The guidelines are based on accident history, risk assessment, target behaviours and target road- user groups, available resources and other policing tasks.

The deployment plan itself is usually considered a local matter rather than a ‘National Enforcement Plan’. Deployment plans of automatic speed cameras and enforcement campaigns linked to national media campaigns are often coordinated in a national or regional context.

In recent years, a growing number of countries include efficiency objectives and performance measures for their government institutions, requiring also traffic policing to show better efficiency in their operations

4.1.3 Disparities between EU Policy on TLE and National TLE concerns

The ‘idealized’ model of traffic policing depicted in Figure 4 is classic enforcement chain superimposed with a planning and evaluation functions. The functional chain describes the process by which police enforcement is presumed to influence drivers to comply with traffic regulations. Traffic law → police detection of offences → citations → administrative or legal sanctions → punishment impact on drivers and others in the form of specific and general deterrence → resulting in increased compliance. Information and media campaigns serve to amplify the impact of enforcement on deterrence. The Recommendation suggests how to plan the detection and how to monitor and evaluate all activities in the chain.

The wider institutional context of the enforcement chain is also somewhat idealized .It appears to assume a single National Traffic Police Force, with a single linear command structure, in control of urban and inter-urban road network. In this ideal situation the required legal, administrative, and financial supports for policing are readily available. The police are accountable to an efficient central government where all ministries and agencies work in harmony. A government that can modify traffic laws when needed and is ready to transpose EU legal requirement into national laws

The reality is more complicated than the ideal situation described above. This has practical implications for the willingness, and perhaps even more important, the ability, of states to implement some elements of the EC Recommendations on Enforcement. It may be more difficult than perhaps expected.

Many countries have more than one police force and more than one Traffic Police entity. Each may have different policies and be under control of different ministries.

Traffic policing is often non- specialized. Policepersons are considered generalists, who can shift to different police tasks, as needed. This situation makes it more difficult to reliably implement any TLE plan. Police manpower for traffic enforcement depends on what happens in other fields of local enforcement.

In all countries, irrespective of the organizational structure of government or of Traffic Police, the details of local Traffic Policing are usually determined at local level, and not by a central plan. It is certainly the case in Federal states and in states with a decentralized system of governance where local authorities and local police forces have a large degree of autonomy.

States vary considerably in the degree of central management, directed coordination, or willing cooperation among the various organization involved in the traffic enforcement chain. It appears that successful implementation of enforcement (or safety management) policies depends largely on effective cooperation and collaboration mechanisms irrespective of the centralization status of a country.

Few states instituted performance indicators for assessing the extent and efficiency of traffic police activity. Such measures are virtually non existent for the other elements of the enforcement chain, particularly regarding legislative work and the courts.

Massive (and efficient) Traffic Policing, as is suggested by the Recommendation, does not come cheaply. However, only National Road Safety Plans (NRSP) in EU states allocated special funding for the new TLE activities the plans advocated. On the other hand, there are growing trends in the EU to limit the size of police forces dedicated to traffic control.

Police forces are generally interested in acquiring new knowledge, enforcement practices and technologies for traffic policing. However, the adoption is rarely just a technical issue. Adoption of new practices requires changes in strategic level thinking, adaptation of legal systems and innovative management practices. These changes can not be quickly imposed by an outside authority but must evolve through internal processes.

Institutional barriers within EU and legal issues regarding EU versus States privileges, (such as the subsidiarity principle and ‘Pillar’ issues, discussed in PEPPER W11 and PEPPER D2) complicate, and sometimes hinder, the definition of EU policy instruments regarding TLE. Once formulated, an EU regulation (or recommendation) is not assured implementation in Member States because of the inherent difficulties, in all states, in the process of transposing the EU law into a functioning National law.

Within states, especially those with Federal or regional autonomy structure, there are also divisions of legal authority and administrative responsibilities, for various aspects of traffic policing that parallel the divisions at the EU level. These, and other institutional barriers, which often exist even in centralized states, between ministries, between central and local authorities, between various police forces- impede adoption of a coherent TLE policy and its efficient implementation.

No state will reject the proposition that efficient and effective management of the direct enforcement chain (deployment – detection – citation – punishment – following up) is needed, as well as that of the process of formulating and implementing the policy levels of National Road Safety and TLE strategies. But this is a classic case of “easier said than done”.

It may well be that many ‘old EU’ states (such as UK, NL, Nordic countries, Germany, France) have had such capacity for many years, developing them since the 1970s and, therefore, could redirect their effort successfully to new focus in TLE, such as massive alcohol screening or automated speed control. France has dramatically succeeded, with great results, in reshaping its TLE policy on the strength of existing functioning institutions, professional knowledge, and decisive and inspirational leadership.

States with underdeveloped transport infrastructure, and lacking relevant functioning institutions and the working cooperation mechanisms between them, might not be able to

benefit much from the act of accepting the Recommendation on Enforcement. The challenges to implementation might prove too high.

In the new EU Member States, perhaps more than in others, there is a growing realization, that in addition to securing legal support and stable funding the state needs to build the capacity of the institutions of TLE, and of Road Safety management in general, before new ambitious plans can be implemented.

A similar position was, in fact, accepted by the Council of Transport Ministers in its 2006 meeting in Dublin. The ministers reaffirmed the EU commitment to the goal of reducing fatalities by 50%, but in addition to the traditional focus on road user behaviour (which is exemplified in the Recommendation on Enforcement) the Council also calls for developing, in parallel, the *institutional capacity to manage road safety effectively*.

4.2 Traffic Law Enforcement chain in the Member States

This section addresses two issues with respect to Figure 4. The first is simply an overview description of selected elements in the 'enforcement chain', particularly those having to do with basic laws, detection, registration and follow up of the target non-compliance behaviours—speeding, drink-driving and non-use of safety belts. The status of cross-border enforcement and the use of media and information campaigns are also considered.

The second issue addressed here is the current availability of data elements needed to be reported to the Commission, according to the Recommendation. This work was utilized to design a conceptual database for TLE information to be collected and reported to the Commission and for use of Member States. PEPPER W5 and PEPPER W29 contain more information about available data elements, the enforcement chain and potential sources for each type of data.

The information in both parts was based on questionnaires to contact persons in several states complemented by recent documents from various sources (such as ETSC reviews) and official websites of relevant ministries in the countries. Nevertheless, the data were not a complete set for each country, so that conclusions are about common or typical situation which may not be accurate for a given country. At most, 16 states, both old and new members (+ Switzerland) are represented here. More detailed description with Tables of data can be found in PEPPER W25 and PEPPER D6.

4.2.1 Description of the enforcement chain

General description of TLE chain in a country can be obtained as a description of institutions, the legal traffic code, the kind of enforcement practices, special equipment that is being used and so on. On the one hand, traffic enforcement systems in different states appear to be similar. Traffic police patrols, speed detection radars, being stopped, being given a citation and a slip to pay in at the post office or an invitation to appear in court, are familiar to drivers and police officers in every state. But on closer examination there are many unique aspects to every system and they are quite complex entities not only in size but also because of the many different institutions involved, each with its own structure, regulations and code of practice.

The '*Enforcement Plans*' that are available in most countries are very generic, mainly principles and not detailed plans. In several countries there is little meaning to the concept of National Enforcement Plan, as the system of policing is under control of Federal states, or autonomous regions or divided into somewhat independent police forces.

Speed limits vary significantly between the countries, especially for motorways and highways. The lack of harmonization of speed limits between the countries may have the effect that drivers do not respect the speed limits in their own country, as they can see that other countries sometimes have higher speed limits on the same kind of roads. Moreover, the changes in speed limits when one travel across the countries may be confusing.

Automated speed violation detection and processing has a great potential for speeding up citation processing and increasing the volume of possible citation and, consequently, their impact. However, in five out of seven countries reported using automatic speed cameras, the processing was essentially manual, thus limiting the benefits of automatic cameras just to the first part of the chain, i.e. the detection of the offence.

Legal responsibility for automatically registered speed violations rests, in many states, with the driver of the vehicle, requiring positive identification of drivers caught on camera. This situation, as is in most Nordic states, limits the full benefit of the system. Full owner liability, as in The Netherlands, combined with administrative legal procedure and automated license plate recognition technology, allow very efficient use of the system. Nevertheless, the UK and other countries instituted an 'owner presumed to be the driver unless owner identifies driver' rule that makes the system very effective even within a fully criminal traffic code.

BAC limits in EU states countries vary from 0.8 g/l to 0.0 g/l. The lowest BAC limits apply in some of the Eastern Member States.

The majority of states carry out screening type random breath testing in systematic drink-driving enforcement as well as a part of the normal traffic surveillance.

Evidential alcohol measuring method of choice is still a blood test, most often in a medical facility. Some states allow evidential breath testing with approved devices in fix central locations, but there is readiness to equip field units with portable evidential breathalyzers; it is only a matter of reliability and cost.

Seat belt use is obligatory in all states. However, almost all of them have also exceptions from the obligatory restraint use. These are typically drivers of vehicles with specific functions, such as taxis, bus drivers, emergency vehicles or drivers with medical reasons. Only half of the 16 countries reports having consistent and repeated enforcement of restraint use.

Sanctions for speeding and drink-driving violations are followed up with fines, and depending on severity of violations other sanctions might follow – court appearance, penalty points, suspensions and even license revocation

Sanctions for speeding violations, typically involve a fixed fine payment procedure (the offence may still be considered under criminal law if driver chooses to contest the fine in court) unless the offence is very serious (large deviation from legal speed) or connected with an accident. In the more serious cases the prosecution is under criminal law, and the court has a

larger set of sanctions including fines, license suspensions, and the possibility of withdrawing the driving license. Point systems and introducing drivers' record in court handle recidivism. In practice, there is very little use of the sanction of impounding the vehicle of an offending driver, even in states that included such sanction in the book.

Sanctions for drink-driving violations typically depend on the severity level of illegal BAC detected, which also determines whether the legal procedure is an administrative fine or a full criminal procedure. Sanctions are more severe in cases of repeated violation. In almost all the sixteen states covered here drink-driving violations are treated severely. Driving license can be suspended in severe cases, and drivers may be imprisoned. In Nordic countries there is a beginning move to require drink-drivers to use alcolocks in their own cars, after successful tests of the system and concept in Sweden, Finland and other countries.

The sanctions for not wearing a seat belt vary a lot between countries. The situation regarding non-use of belts is unique, as it applies to all occupants, including children, but the issue of responsibility is not always clear in the legislation, and certainly not to the public.

The sanction for non use of restraints is never more than a fine, usually on the low end of the scale of possible fines. In eight countries fines are combined with the minimum number of demerit points. In three countries drivers receive a higher penalty for non-compliance by children in their vehicle, up to the possibility of suspension of driving license for a period of time.

The reported mean time for a speed violation prosecution to come to court varies from 1 to 12 months, while the mean time for a drink-driving violation to go to court varies from 1-6 months. However, these numbers are based on information only from a few countries. The length of the period may depend on the seriousness of the violation, as well as the caseload of the courts.

Most of the surveyed states have some version of a *Demerit Point System*. Others are still debating if to add such an administration to the arsenal of citation consequences. In most states a driver cited for non-use of safety belt is not receiving points.

Nine countries have *rehabilitation schemes* for repeat offenders. Usually these are points-linked compulsory lessons about traffic safety and driving. Sometimes voluntary or court referred participation could be in lieu of a more serious sanction. Few countries have special, treatment programs, for repeat drink-driving offenders, also linked to court mandatory referrals. The impacts of these programs on violations or on safety are unknown or ambiguous.

All EU countries use the Media to inform the public at large about a NRSP, new legal initiatives, and local actions in the area of TLE. The extent of informing and involving, however, varies considerably among countries.

Media Campaigns about compliance and safety are carried out in all states, almost exclusively in relation to speeding, drink-driving and seat belt use. It is not very clear to what degree the campaigns are linked to enforcement actions.

Cross-border enforcement (detection, sanctioning, fine collection and other sanctions of non-resident drivers / vehicles) varies from state to state depending on the number of borders it has

with neighbouring countries, the amount of cross-border traffic moving across and the kind of bi- or multi- lateral agreements it has with neighbouring and more remote countries.

In traditional enforcement, there are various options for on-the-spot fine collection for any violation by a non-resident (since the vehicle is stopped by police), including temporary prevention of driving by a drunk driver. These options are unavailable in the case of automated camera enforcement, and unless special provisions are made for identification and further processing of non-resident violating vehicles, their drivers / owners may escape any prosecution. With increasing ratio of speeding violations detected automatically, the issue of prosecuting non-resident violators becomes more acute.

In the case of cross-border lorry and bus traffic, in addition to the potential of committing driving violations as any car driver, these types of vehicles have to abide several regulations concerning hours of duty, special equipment, cargo documentation and more.

Information from 13 countries shows that in most of the countries cross-border enforcement either does not exist or it is only practiced to a limited degree. Only in three countries it is possible to apply the complete enforcement chain on speeding, drink-driving and restraint use violations by non-residents. Nordic countries have functioning multi- lateral agreements on TLE between them, and so do the Benelux states. France and Germany each have agreement with some of their neighbouring states.

It appears that the main problems are with new Member States that are not, as yet, party to joint agreements, and lack the administrative support to exchange information and handle (at this point still manually) claims forms and requests from and to other countries. With the recent proposed Directive on Cross-border Enforcement (EC 2008) the situation is likely to improve considerably. PEPPER D3 discusses the issues of cross-border enforcement in more detail.

4.2.2 Availability of data elements to be reported to the Commission

Data about specific Enforcement Plans in the target non-compliance areas are presently limited for all Member States, as this information is considered an internal tactical matter subject to local modification. In many states there could not be one National Enforcement Plan, as there are many jurisdictions, each doing their own operational planning. General guidelines for planning enforcement are available, but similar guidelines could produce very different operational plans given local conditions and resources.

Data about actual implementation of traffic policing, are especially scarce. Countries with Road Data Observatories can provide some behavioural indicators. At present, no country can provide reliable national data on actual deployment of police enforcement, especially not in urban areas.

Accident data are available in all countries: They are collected routinely in all European countries, and sent to the IRTAD database. Many countries also collect limited data on some of the indicators related to speeds, drinking and driving and seat belt use. Data on other non-compliance behaviours are scarce. The concept of Road Safety Observatory is perhaps the closest to the needed entity to monitor and assess the relevant safety and TLE performance indicators in a country.

Data about speeding: Most of the countries are collecting data concerning Automatic speed enforcement equipment, violation and sanction statistics, and speed enforcement procedures. Data on changes in speed limits and regulations are also available, but may be quite spread out across many jurisdictions. Less than half of the reporting states collect information on court decisions. Statistics of speed violations by foreign vehicles and drivers is the least covered area. Actual speed behaviour of traffic is measured in several countries in fairly systematic manner, but the link between these measures and traffic police operations is rarely examined.

Data about drink-driving: Most of the countries are collecting aggregate data concerning random and evidential breath testing as well as violation and sanction statistics. On the other hand data on court decisions and statistics on violations by foreign drivers are scant.

Data about restraint use: The data collection regarding restraint use is most extensive when it comes to non-compliance rates, as these are based on road surveys performed by non-police organizations. Statistics on sanctions are less common, as in many countries these safety belt violations are not recorded. There are hardly any data on Court decisions and not at all on violations by foreign vehicles and drivers.

All countries reported that they do not have a designated office (*Enforcement Coordination Point*) in charge of collecting the TLE data from the many sources in a country. In some countries a concern was raised about who in a country will take on the very sizable administrative burden required to collect and organize the information requested in the EC Recommendation and also concerns about sharing it (especially the tactical planning and deployment aspects) with the EC and other countries.

4.3 Perceptions and opinions of TLE professionals, Stakeholders and the General Public

EU policy statements and actions in the field of Road safety, including the Recommendations on Enforcement, are a product of exchanges, consultations, deliberations and negotiations that involved many stakeholders at the EU level (including National stakeholders such as Ministers of Transport and members of the European Parliament). Nevertheless, the adoption and actual implementation of EU policies and actions, such as the Recommendation, in Member States, is not automatic.

Also within each state, many processes- of exchanges, consultations (formal and informal), lobbying, negotiations between stakeholders- take place in the course of introducing new TLE laws, policies and practices. Law makers, political decision makers and TLE practitioners are all attuned to the opinions of each other and to those of other stakeholders and the public; they might influence each other or at least learn the limits of their power.

This section examines the opinions of various kinds of TLE professionals (persons working for police agencies, justice departments, ministries of transport, road authorities) stakeholders politicians, local and national government employees, researchers and academics), and the general public. The opinions sought after were about TLE enforcement in their states in general, and more specifically, regarding the central issues promoted by the Recommendation – speeding control, automated enforcement, drink-driving control, random breath checks,

enforcement of safety belt use, cross-border enforcement, harmonization, innovative technology for enforcement, obstacles to effective enforcement.

Interviews with professionals and stakeholders were conducted with selected persons in a small number of countries. Overall, about 150 professionals and stakeholders were interviewed in eight different countries (Czech Republic, Finland, France, Greece, Lithuania, Poland, Sweden and the UK). For opinions of the public data from previous representative surveys that addressed similar issues were used: the EU-wide SARTRE 3 study and recent national surveys in a number of countries. More detailed descriptions can be found in PEPPER W15, PEPPER W17, PEPPER W31, and PEPPER D7.

4.3.1 The perceptions and opinions of TLE professionals

Current national safety and TLE practices: Road safety was seen to be high on the political agenda by interviewees from Finland, France, and Sweden. In the other states it was felt that in practice, political support for safety and TLE was not sufficient. They specifically mentioned failure to pass supporting legislature, providing funds and approving purchases of modern enforcement technology.

Professionals from a number of countries, old and new EU states, observed a general government trend to cut ministerial resources, especially in terms of personnel, and expressed concern about the resulting decrease in traffic police presence on the streets and roads. They believe that the public wants and needs to see the police for its enforcement to be effective and for the citizen to feel secure.

All interviewees approved their state's enforcement policies in the key areas of *speeding*, *drink-driving*, and *seat belt use*. They fully supported the use of automatic cameras for speed enforcement, even in countries where the use of the method was not yet common. Compared to studies 7–9 years ago (e.g. in ESCAPE project) there was much wider acceptance of automated speed cameras and not much concern about privacy issues in relation to using such systems.

In countries that practice *random breath testing*, enforcement professionals fully supported it, whereas UK interviewees did not consider it a superior method to their own, which is more selective testing, of suspected drink-drivers. The idea of alcolocks was acceptable to professionals who have had some experience with them (from Sweden, Finland) but met with scepticism by others.

Beliefs about the views of the general public: Interviewees believed there was good public acceptance of enforcement, in all areas, especially of drink-driving. The general public in Lithuania, Poland and Sweden was seen as less accepting of strict speeding enforcement. Interestingly, Swedish drivers in the SARTRE 3 Survey indeed expressed relatively strong pro-speed attitudes. Czech Republic professionals believed that their public is not in favour of enforcement of seat belt usage.

Cross-border enforcement and harmonisation: Generally, most professionals agreed with the spirit of the Recommendation. They only expressed practical concerns about its implementation. A major concern was the extra administrative workload anticipated from the

requirement to follow, record and report all the processing steps in the enforcement chain (the interviewees said it in different words).

They generally liked the idea of harmonized traffic codebook, especially regarding cross-border traffic, but expressed various practical concerns about the functionality of legal, administrative, and technological machinery needed to make it happen.

There appeared to be a stronger support for Harmonization of TLE policies and practices and for the Recommendation, among professionals from the New EU states, compared to the Old EU states, despite the fact that they also expressed more concerns about the ability of their states to fully comply with the Recommendation. One possible reason for the somewhat paradoxical position is the belief that by committing themselves to a policy like the Recommendation, the political and institutional leadership in the state might in fact, invest in the legal, organizational and material resources needed to implement the policy.

On the other hand, in Old EU states, such as Sweden and the UK, interviewees were concerned that harmonisation might lead to a *weakening* of their high level road safety standards and proven enforcement practices, or that it might lead to a single authority overriding national and local authorities.

4.3.2 The perceptions and opinions of stakeholders

Current national safety and TLE practices: The special importance of effective enforcement of the target areas the Recommendation underlined – speeding, drink-driving and seat belt wearing – was universally recognized. Stakeholders in the UK and Sweden were pleased with their current policy and strategies arguing that they already had achieved a great deal. They also stated that further improvements are obviously needed and that this will be very difficult.

Stakeholders from the other states were dismayed by the high rate of road accidents in their countries and criticized several elements of their countries safety management. They pointed particularly to policy inconsistency and lack of effective institutional actions to follow up the various political and legislative initiatives. The state of economic development, unique socio-cultural attributes and the current status of technological devices, were some of the factors mentioned as influencing the actual intensity and impacts of traffic policing.

The use of speed cameras and other technologies: In general, there was a positive sentiment for using modern technology for police Traffic Law Enforcement and as means to increase compliance even without direct police involvement. Reservations were expressed about over-reliance on automatic technology (such as speed cameras) since this could reduce the important role of police surveillance. Surveillance was seen as crucial for dealing with a host of risky and illegal driving behaviours other than speeding and drink-driving.

Most stakeholders expected the current trend in enforcement technology to continue. They felt that a balanced combination of technology and traditional on-road police control was the most productive combination. In-vehicles driving-aid devices were regarded as an effective way to improve compliance with traffic laws.

Drink-driving enforcement: There was general agreement that blood based medical BAC testing takes time, is expensive, and reduces the efficiency of police enforcement. In some

countries current legislation requires blood testing in a hospital setting as evidence of an illegal BAC. This is despite the fact that the police are often equipped with breath testing units that are as precise as blood testing. Therefore, there is general support for the idea of field level evidential breath testing devices. Stakeholders supported their state's practice of random breath testing, or more targeted testing as in the UK.

It is interesting to note that particularly among politicians there was some dissatisfaction with the "official" policy of random breath testing. They suggested more targeted breath-testing, instead or in addition to the random breath testing procedure. In this, they may have echoed some public sentiment, expecting more positive detection of suspected drinkers instead of stopping every driver.

Beliefs about the views of the general public: Stakeholders believed that the general public was in support of traffic enforcement, in their countries. For example, Parliament members in the Czech Republic believed that the General Public supports the new safety measures announced in 2007 and that most people accept the idea of more traffic police control, especially with respect to drink-driving. The politicians credited positive media and directed campaigns for the strong public support. Social rejection of drink-driving and support for intensive enforcement in that area were mentioned by stakeholders as an example of good synergy between information campaigns, media discussions and police enforcement.

The politicians, and other stakeholders, were aware that the support for new TLE measures was tempered by citizens' concerns about human rights and privacy issues, particularly regarding automatic cameras, mass records and "vehicle owner responsibility". At the same time, stakeholders also recognized that some of their citizens believe that traffic enforcement was a way to collect revenues rather than reducing accidents.

The impression one gets from reviewing the answers and comments of politicians among the stakeholders who were interviewed about TLE policies and practices, is of personal opinions not very different from those of drivers in surveys such as SARTRE (see next section and W15 of PEPPER).

A study in Finland compared the opinions of parliament members and the public directly, using the same questionnaire (Keskinen, Hernetkoski & Hatakka, 2006). The views of MPs and citizens about road safety, the role of police enforcement, and the desirability of specific enforcement measures in the areas of speed and drink-driving control, were rather similar. Citizens and MPs alike, preferred safety measures targeted to individual road users, rather than to the traffic system. MPs impressions of citizens' views were fairly accurate, even though MPs thought themselves to be more committed to traffic safety than citizens. In fact, citizens sometimes expressed stronger support, than MPs, for certain TLE measures.

The issue of Harmonisation: It was frequently pointed out that many difficult problems need to be resolved, most of all political and regulatory barriers, before this could happen. A number of interviewees noted the importance of a nation's social and cultural characteristics in shaping its TLE system and the need of European TLE policy makers to be sensitive to national differences.

Harmonization of BAC limit (to presumably the most common level of 0.5‰) was one example given to demonstrate how the issue of harmonization may have quite different

consequences in different countries, and perhaps should be left for each country to decide what suites it best. In the Czech Republic, such harmonizing would mean backing off the successful policy of 'zero limit' while in the UK it would mean lowering the limit from a level the UK finds as appropriate to its culture and enforcement system.

4.3.3 The perceptions and opinions of the General Public

This section is based on information from six representative public opinion surveys on issues of road safety, self-reported driving behaviour, traffic enforcement, as well as other related topics. Data sources included the European project, SARTRE 3, (SARTRE, 2004), which covered 24 countries (with Israel added later to the database); supplementary analysis was performed following the Israel study (Zaidel, 2007), and recent surveys in Switzerland, the Czech Republic, France and the UK.

Support of current national safety and TLE practices: Road safety was recognized by more than half of the drivers in SARTRE as the main objective of Traffic Law Enforcement. Drivers overwhelmingly support the need to enforce speeding, belt use and drink-driving. The support for the enforcement of drink-driving is strongest. In many countries in the EU safety belt use is not perceived by drivers as a critical issue anymore, as most of them already use belt regularly. Reported experience of receiving a seat belt citation in 3 years varied from 1% to 20%, in different countries, so the actual non-compliance, even among drivers, is not negligible.

Confidence in the police: A sizable percentage of drivers don't think that traffic police 'catch' many of the offenders, but the process itself is considered fair. However, there are still quite large differences between European countries, in terms of the fraction of the driver population that do not trust traffic police.

A "lack of confidence in the police" index was calculated as a percentage of drivers, in each country in the survey, who had a totally negative opinion on each of five questions in SARTRE regarding the traffic work of their police: 'police do not catch most traffic offenders'; 'police do not concentrate on safety important offences'; 'treatment of offences is not quick and efficient'; 'severity of the punishment is not appropriate to the severity of the offence'; 'drivers are not treated equally'. (The actual wording of questions was on a positive scale).

Overall, 10% of the drivers expressed mistrust in the work of traffic police. Among EU states the percentage ranged from 2% to 22%, with no obvious relationship to national characteristics, such as safety standing, size, region, old vs. new EU Member States.

More recently, in a Czech survey following an introduction of a new package of Traffic Laws (Czech Road Traffic Act, 2006), the majority did not believe that the police treated all drivers in an equal way and a large proportion (70%) believed that 'traffic enforcement was a way to collect revenues rather than reducing accidents numbers'.

Experiencing speeding, drink-driving and restraint enforcement: A large proportion of European drives had never been checked for alcohol. The risk of encountering speed enforcement was twice as likely compared with drink-driving enforcement. Seat belt enforcement was hardly noticeable. However, the differences between states were large, reflecting both police activity and the 'objective' need to engage in the activity. For example,

7% to 47% of drivers in different countries reported receiving a speeding citation in the course of three years. Seat belt citation experience, on the other hand, ranged from 1% to 20% of drivers in different countries.

According to the above national survey in the Czech Republic, the probability of encountering a police control during a typical journey was considered as low. Furthermore, 58% of the drivers believed that only a small fraction of offences were detected by the police, which would suggest that the risk of detection, despite increased enforcement, was seen as rather low.

Attitudes towards automated cameras: Support for speed and red light cameras ranged from 14% to 56%, in different countries, with an EU mean of 30% support for speed cameras and 37% support for red light cameras. It appears that drivers from countries that already had many cameras in use tended to have more negative opinions about them.

In France, the large scale implementation of a camera-based, automated speed control system (known as 'automated controlling and sanctioning system or CSA), took place after the SARTRE survey. A separate survey examined drivers' self reported behaviour and opinions about the new system of speed enforcement (ONISR, 2006).

76% of the drivers reported paying attention to speed limits more than before, although this meant that many of them were slowing down just near the locations of the cameras. The experience of getting a speeding ticket quickly was reported by drivers as having the strongest influence on them.

The credibility of the information given to the public was also assessed in the survey. More than half of the drivers believed that the location of the camera was chosen according to the number of accidents. Most drivers also believed in the reliability of the system and in its effectiveness in reducing accidents.

The group most in favour of the CSA tended to be the elderly and people who have negative attitude towards speeding. However, concurrently with the previous opinions, 78% of the drivers also believed that the radar-camera system was an effective way to collect money from drivers.

British drivers have had a longer experience with speed cameras. The Royal Automobile Club (RAC) sponsored a survey of drivers' attitudes to cameras and other driving issues (RAC, 2007).

73% of the surveyed drivers indeed agreed (strongly or slightly) with the statement that 'Speed cameras are more about raising money than improving road safety' but on other direct questions on speed control, 56% believed that speed cameras and radars contribute to safety, 52% believed that speeding is a serious unsafe behaviour and even higher percentages supported lowering speed limits in urban areas. So it appears that drivers can maintain a cynic attitude about the government as a tax collector, in parallel to accepting speed cameras as a safety- useful device.

Attitudes towards drink-driving enforcement: The vast majority of EU drivers supported stronger sanctions for drink-driving. Drivers in countries with the poorest road safety situation were more inclined to support severe punishment and restrictive measures, in general,

compared to drivers from 'safer' countries. The recent UK study reported that among British drivers there was strong support for random breath testing, lower BAC limits and harsher penalties for drink-driving.

A survey carried out in Switzerland examined the effect of a reduction of the BAC limit from 0.8‰ to 0.5‰. Before the reduction 65% were in support of the move, but after the reduction took place the support had increased to 86%. The same effect was noted about acceptance of random breath testing. Hence, the study demonstrated, again, the well established finding from other countries and for many safety measures (e.g. belt use, daylight running lights, urban speed limits) that a change in legislation (sometimes even before there was time to experience its consequences) may shift peoples' views in the direction of the intended change.

4.4 Conclusions

1. The three major Road Safety policy documents of the EU are: *The White Paper on European Transport Policy*, *The European Road Action Programme*, and the *Commission Recommendation on Enforcement in the field of Road Safety*. The first was a guiding vision and provided a challenging safety target; the second document suggested strategic areas of actions that included harmonizing traffic regulations and upgrading Traffic Policing; and the third document proposed a specific plan about *how* Traffic Policing should be carried out in Member States.
2. Interviews and surveys of politicians, traffic law professionals, other Stakeholders and the general public, suggest wide support for EU safety policies. The strategic goal of halving the number of road fatalities in Europe by the year 2010 is accepted by all institutional stakeholders at the EU level, by Member States and the public. There is a universal recognition that Traffic Law Enforcement has an important role in maintaining legal and safe road user behaviour, but also that it can and must be made more efficient and effective.
3. Most of the practices promoted by the Recommendation – massive speeding control, automated speed enforcement, firm drink-driving control with massive random breath checks, systematic enforcement of safety belt use, cross-border enforcement, use of innovative enforcement technologies – are indeed supported by most stakeholders in all Member States. Compared to studies performed 7–9 years ago there was much wider acceptance of automated speed cameras and not much concern about privacy issues in relation to using such systems.
4. Massive Traffic Policing, as is advocated by the Recommendation, does not come cheaply. Yet, only few Member States allocated special funding for the new, or more massive, policing activities their national safety strategies declared. On the other hand, there are growing trends in the EU to limit the size of police forces dedicated to traffic control.
5. Drink-driving legislation and enforcement practices enjoy strong support from all stakeholders, in each state. There is support for even stronger sanctions against drink-driving. The idea of Alcolocks was acceptable to stakeholders who have had some experience with them, but met with scepticism by others.

6. Stakeholders like the idea of increased harmonization of cross-border enforcement, even as they express practical concerns about the functioning of the legal, administrative, and technological machinery needed to make it happen. The support is stronger among professionals from the new EU Member States.
7. There is less agreement, within EU institutions and among professional / institutional stakeholders in Member States, about the legitimacy, feasibility, practicality or desirability, of having a top-down, EU mandated Traffic Law Enforcement policy that goes into specific tactical issues of “*how to do traffic policing*”, or that requires sharing detailed law enforcement information with external jurisdictions, including an EC agency.
8. Police forces (especially those dedicated to traffic work) have internal operational guidelines for tactical deployment of personnel, vehicles and equipment for traffic policing tasks. The guidelines are based on accident history, risk assessment, target behaviours and target road- user groups, available resources and the needs of other policing tasks. The deployment plan itself is usually considered a local matter rather than that of a ‘National Enforcement Plan’. It is certainly the case in Federal states and in states with a decentralized system of governance where local authorities and local police forces have a large degree of autonomy.
9. State-wide data about the detailed police deployment plans regarding enforcement of speeding, drink-driving and safety belt are simply not available in any state. The same holds true for the data about actual police deployment, which could be very different from plans.
10. Some states (e.g. France, Norway, The UK, The Netherlands, Spain, and Finland) have started instituting systematic collection of traffic and road user behaviour measures as well as performance indicators for assessing the extent and efficiency of traffic police activity. Such measures are virtually non existent for the other elements of the enforcement chain, particularly legislative work, follow-up on citations and the courts.
11. Most traffic law systems in EU countries are a mix of criminal and administrative law. A comparison of countries with criminal traffic law with those having primarily an administrative traffic law, suggests that the nature of the legal system is not a determining factor in the level of road safety in the country.
12. Institutional barriers within the EU, and legal issues regarding EU versus Member States’ privileges (such as the subsidiarity principle and ‘Pillar’ issues), complicate, and sometimes hinder, the definition of EU policy instruments regarding road safety and Traffic Law Enforcement. Once formulated, an EU regulation (or recommendation) is not assured implementation in Member States because of the inherent difficulties, in all states, in the process of transposing the EU law into a functioning National law.
13. In many of the EU states there are institutional barriers between ministries, between central and local authorities, between various police forces, which impede adoption of a coherent new Traffic Law Enforcement policy and its efficient implementation.
14. Member States vary considerably in the degree of central management, directed coordination, or willing cooperation among the various organizations involved in the

‘traffic enforcement chain’. Successful implementation of enforcement (or safety management) policies, depends largely on effective cooperation and collaboration mechanisms, irrespective of the nature of governance on the centralization / decentralization dimension. However, decentralised systems seem to have developed more advanced collaboration and other ‘horizontal management’ mechanisms.

15. Police forces are generally interested in adopting new enforcement practices and new technologies for traffic policing. However, the adoption is rarely just a technical issue. It requires changes in strategic level thinking, adaptation of legal systems and modifying management practices.
16. The evidence seems compelling that massive speed control and continuous drink-driving control had a decisive role in bringing down road fatalities in France, substantially and relatively quickly. This appears to be a successful, pre- ante, example of the strategy suggested by the EC Recommendation on Enforcement. The question is: will the same thing work in more EU states, or in other countries? A related question is: what prevents other countries to follow suit?
17. The French example shows that successful upgrade of a TLE system and general safety management requires the prior availability of institutions capable of handling the upgrading and successfully working out cooperation mechanisms between the many institutions. In other words, the potential capacity must be there, so that when political leadership is prodded into action there is the legal and administrative bureaucracy, the professional knowledge and skills, the readiness of mass media to promote safety, and the funding to implement whatever the new safety policy is about.

5. MODEL FOR TRAFFIC LAW ENFORCEMENT DATA COLLECTION SYSTEM AND DATABASE

The results presented in this chapter are based on PEPPER deliverables 8 and 12.

5.1 Background

What if we could quantify the effects of different TLE activities and hence choose the most cost-efficient ways of influencing traffic safety by means of TLE? This can only be achieved if we operationalize the various TLE actions and have quantitative and comparable data on both the enforcement actions and the safety outcomes. In addition, we need a system able to connect these data. In the PEPPER WP2 the aim was to provide tools for this and to develop a conceptual model for European TLE database (DB), including a model for data collection system (DCS). The purpose was to provide input and conceptual tools for a possible creation of a database that would allow monitoring the efficiency of TLE actions on a European level.

The idea of an EU level database has already been elaborated in several areas of human activity. Such databases, already in operation, have been constructed also for the area of transport. They are gathering, keeping and updating a large amount of data from several EU countries. Based on a search in the web, it can be concluded that most of the existing EU level databases in the area of transport had to do with road safety and accidents. The main source of information about these databases was ERSO website (www.erso.eu), which might be of interest for the reader too. It can however also be concluded, that in the field of TLE, such a database is yet missing.

Of the existing databases CARE, IRTAD and EUROSTAT are especially interesting and relevant in their organization and structure, if a Europe wide TLE database is to be developed. There are however several other processes involved in the development of a database model besides reviewing already existing databases. The availability of the input data, the output considerations, and the general functionality of the system has to be considered. In the present chapter, the conceptual model and related considerations are presented.

The general scope of the work regarding the design of the TLE database and a Data Collection System was that the work was carried out *on a conceptual or logical level*. Working on a fairly high level of abstraction means that only very little about specific technical issues and choices between different technical solutions was produced during the process. Each phase of the developing process demands its own technical solution. In this context, the work performed in WP 2 can be regarded as an input to the demand specification that must be produced at a possible later stage, where the database system is going from the planning phase to the development phase. Afterwards it will be the job of the preferred bidder to outline which technical solutions in practice are best suited for handling the demands.

The present work is based on the considerations and experiences on the TLE data gained along the work in the WP and a set of assumptions on how to best solve the task of developing a DB and a DCS, which will be accepted by the users and will be able to handle data in such a way that demands on the output side can be met. These assumptions might be subject to change

later on in the development process, as demands regarding database structure and output are going to be clarified.

5.2 Conceptual model for European Traffic Law Enforcement database: The data chain

When designing a DB and a DCS, it is necessary to consider carefully, first the data output features, needs and requirements, second, the data input options, requirements and strategies, and third, the database structure and functionality. A central conception in the work in WP2 was the importance of focus on *the entire data chain* from input to output of data (see Figure 5). We had the following reasons for this approach:

- The demands on the output side focus on presenting well-defined, structured data – typically in a context where data from a number of different sources is presented as a whole to give the user an overview on a given subject. This means that data must be joined together across data sources (e.g. from different countries) and across different variables, as for instance when comparing data on planned and actual enforcement actions.
- On the input side, focus lies on how to support data delivery on a single question and single user level. In other words, the focus is much more disaggregated than on the output side – and this has clear implications on the way data must be collected and saved.
- The bottom line of this is that development on the input side is inextricably linked to the demands for data on the output side.
- Among the issues that have to be taken into account on the input side to secure a reasonable quality of output, are: different aggregation levels, different units of measurement, incomplete data, flexibility towards changing definitions and changing needs etc.

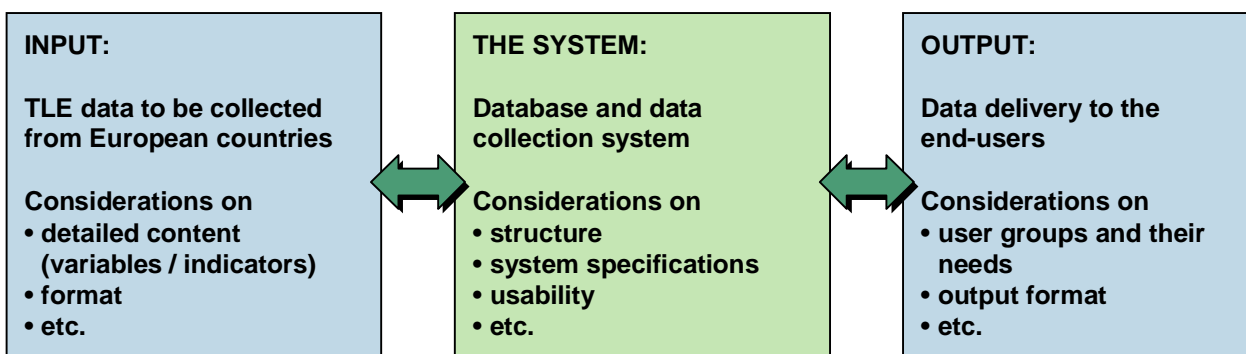


Figure 5. The data chain.

5.3 Conceptual model for European Traffic Law Enforcement database: The output data requirements and needs

When designing a database model, it is important to consider the desired and expected output. It is necessary to ask who needs the output, who will use it and how. One user for the output can be the European Commission, another could be the research community. In our work and assumptions, we did not want to exclude any potential user group but rather kept our approach quite general. That is, the expected users could be both the policy makers and the researchers.

Our assumptions regarding output data needs were as follows:

- EC Recommendation on Enforcement (European Commission 2004) outlines which types of information the Commission expects to receive in the fields of speeding, drink-driving, and non-use of seat belts. In total, there are 512 items/variables to be extracted from the Recommendation. In the short run, it must be expected that the fulfilment of these demands is not possible (i.e. collection of all the items). Therefore a set of more limited demands, in the form of Enforcement Performance Indicators (EPI), combined with Safety Performance Indicators (SPI) have been listed. This resulted in 55 items (or alternatively 103 in expanded form; for more information of the EPIs, see later in the text in this chapter. For detailed description of EPIs and SPIs, see also chapter 7).
- The information required by the Commission is also likely to fulfil most requirements that are to be expected from national and regional authorities in the field of traffic safety. But for some purposes there will be a demand for more detailed information on distribution over time, geography and so on. This means that the system design will have to be flexible in terms of handling more detail where data is available and there is a demand for the information.
- For scientific and some administrative purposes data deliveries on a disaggregated level will be essential. The amount of data available will probably not be sufficient for the delivery of disaggregated data until a later phase.
- The authorities responsible for delivering data are an important factor. It is vital that they feel their efforts are worthwhile, so they must be reassured that the system is actually used according to their expectations, and that the system can also provide knowledge in areas and with a level of detail that is useful for them.
- It must also be expected that many of the more aggregated results from the database can be made available to the public, in order to support the growing public awareness of the benefits of most TLE-activities.
- Access to the output data will most likely be through a web-based user interface, where data can be consumed through the use of a set of standard tools, as tables, graphs, maps, download of detailed data sets etc.
- Finally, the demand for output data from a TLE database must be assumed to change during the lifetime of the system, moving towards a need for more and more detailed data and more complex types of analysis as the quality and amount of input data increases.

5.4 Conceptual model for European Traffic Law Enforcement database: Input data and data collection practise

5.4.1 Data variables for describing TLE efficiency

In order to operationalize TLE actions and their efficiency, it is necessary to identify variables and data needed for describing and assessing the efficiency of Traffic Law Enforcement. In PEPPER WP 2 this was done in a process with several steps. First, relevant literature sources were reviewed in order to translate theory into variables and indicators for assessing Traffic Law Enforcement efficiency. Second, the enforcement indicators from EC Recommendation (European Commission, 2004) were extracted. Finally, a preliminary list of variables and indicators suitable for monitoring efficacy of the law enforcement was presented. This list of variables and indicators described which information should be obtained in order to give an overview of the efficiency of TLE in different countries, and it formed the basis for the final list of enforcement data to be collected that was later applied in the pilot studies.

The set of the most essential EPIs proposed were as follows:

Speeding

- Legal Speed Limit (km/h)
- Existence of a NEP (yes/no)
- Number of planned control periods per year
- Number of controls
- Number of hours to be used
- Number of measurements (number of vehicles or drivers to be checked)
- Number of actual control periods per year
- Number of planned controls
- Number of hours
- Number of locations (or stretches) where the controls took place
- Number of automated devices
- Number of violations (number of vehicles exceeding the speed limits)
- Number of violations as % of number of motor vehicles (or number of driving licences) in the country
- Number of sanctions issued
- Number of sanctions as % of number of violations
- Number of sanctions as % of number of motor vehicles (or of driving licences) in the country

Drink-driving

- Legal BAC limit (per cent or gr/l) (optional: BAC limits for various driver's groups, i.e. novice, professional drivers etc.)
- Random Breath Testing (RBT) is legal (yes/no)
- Evidential Test can be used (yes/no)
- Existence of a specific NEP related to drink-driving (yes/no)
- Number of planned control periods per year (e.g. two control periods: one in summer, one in winter)
- Number of controls (how many times enforcement actions will take place)
- Number of hours to be used
- Number of measurements (number of drivers/vehicles to be checked)
- Number of control periods per year
- Number of controls done (how many times enforcement actions took place during the year)
- Number of hours
- Number of locations (or stretches) where the controls took place
- Number of violations (number of drivers not complying to the law)
- Number of violations as % of number of motor vehicles (or of driving licences)
- Number of sanctions issued
- Number of sanctions as % of number of motor vehicles (or of driving licences)
- Number of sanctions as % of number of violations

Restraint use

- Mandatory Restraint Use (yes/no)
- NEP specific to restraint use exists (yes/no/planned)
- Number of control periods per year
- Number of controls (how many times enforcement actions will take place)
- Number of hours to be used
- Number of measurements (number of vehicles or drivers to be checked)
- Number of control periods per year
- Number of controls done (how many times enforcement actions took place during the year)
- Number of hours
- Number of locations (or stretches) where the controls took place
- Number of violations (number of non-restrained car occupants)
- Number of violations as % of number of motor vehicles (or of driving licences)
- Number of sanctions issued

- Number of sanctions as % of number of motor vehicles (or of driving licences)
- Number of sanctions as % of number of violations

It should be noted that almost each of these items had sub-variables and the set could thus be expanded if the information was available.

Once the extensive list of TLE variables was created, it was decided to examine the availability of this data. This was done in four countries: Belgium, Denmark, Greece and Spain. The main finding was that the information available varies from country to country and that in general only little information is available – especially on certain aspects of TLE, such as recidivism, follow-up procedures and court decisions. It was concluded that while the Member States have widely adopted strategies to prioritize enforcement according to the EC Recommendations, the possibilities to assess the impact of this is difficult due to the scarce data available. Therefore, a more systematic approach on TLE data registration, as well as more systematic implementation of the EC Recommendation in member countries was viewed as a crucial step towards a European-wide data system.

Based on the list of the relevant data to be collected and the data availability information, four-fold tables describing the most essential EPIs were created, given the data availability at present. These tables are illustrated in Figures 6–8.

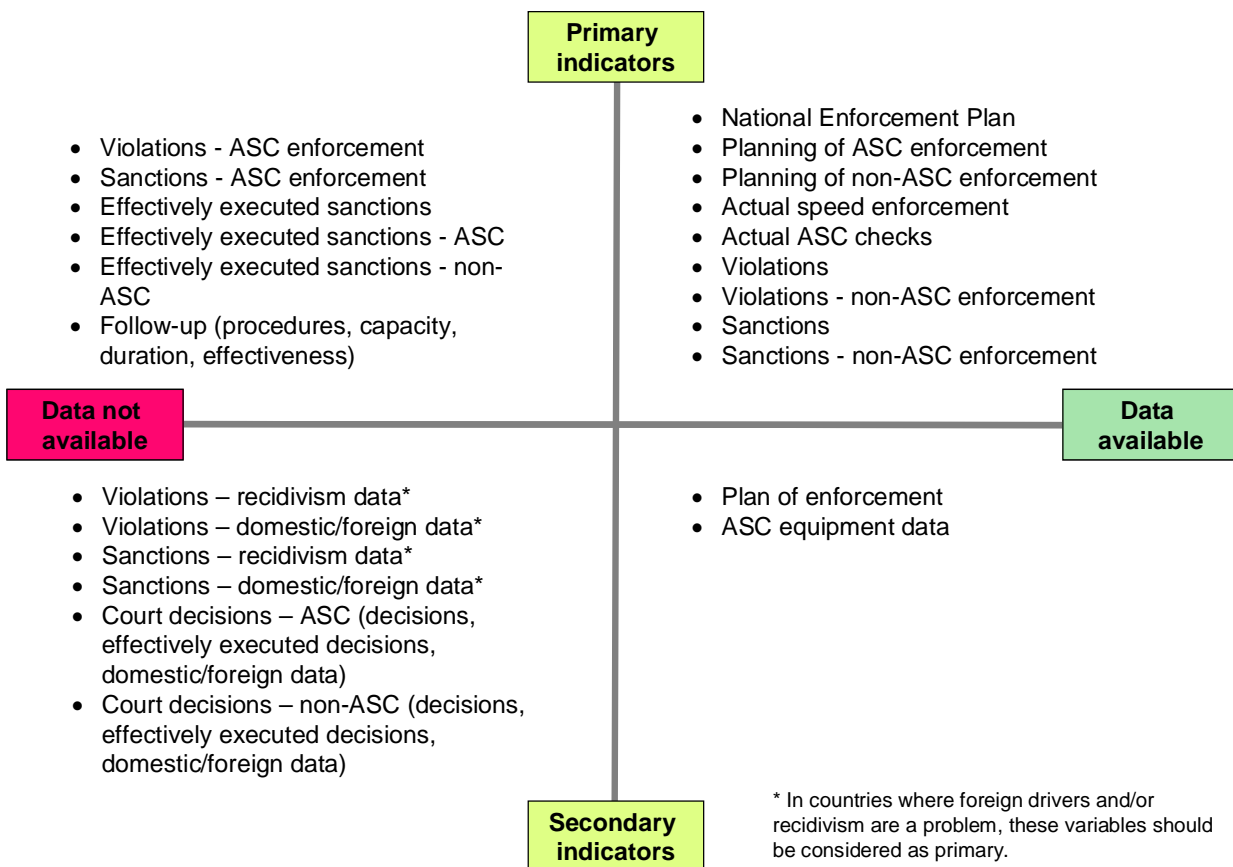


Figure 6. Four-fold table describing the importance and availability of enforcement performance data in the area of speeding.

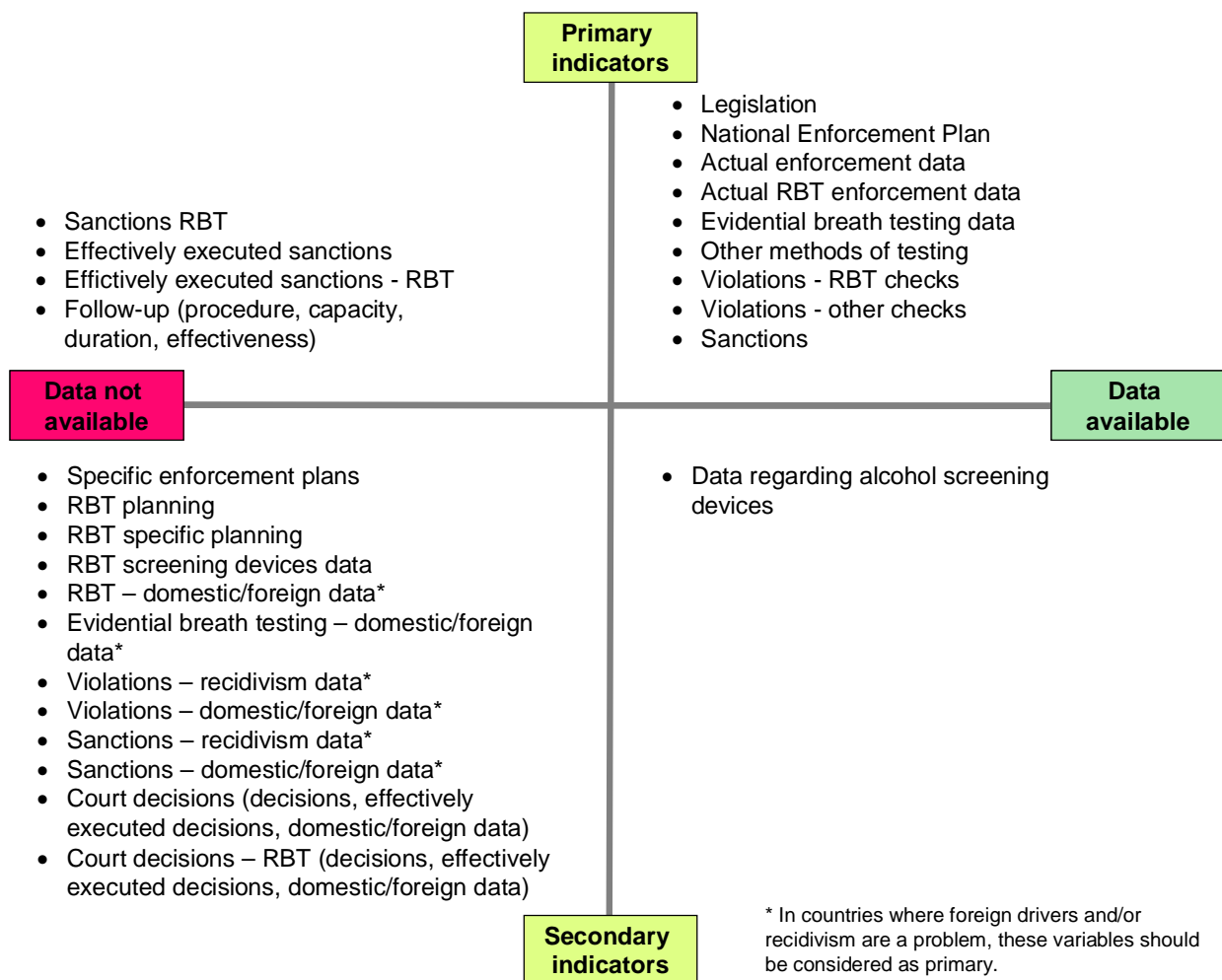


Figure 7. Four-fold table describing the importance and availability of enforcement performance data in the area of drink-driving.

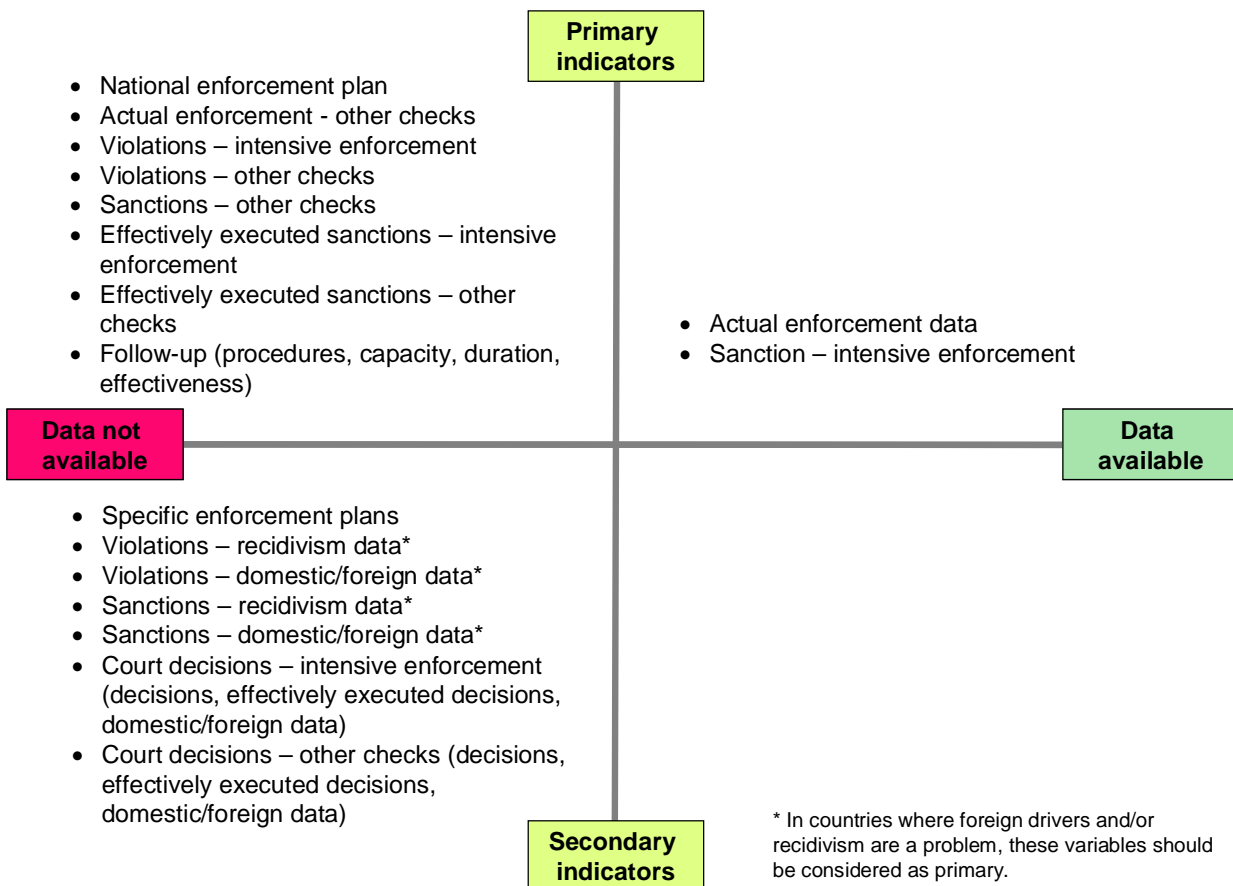


Figure 8. Four-fold table describing the importance and availability of enforcement performance data in the area of restraint use.

5.4.2 Data availability and database development: lessons learned from the pilot study

After identifying the list of relevant TLE data, it was feasible to try out the data collection. Data collection pilots were carried out in Austria, Belgium, Czech Republic, Denmark, Greece, Sweden and Switzerland in March-August 2007. It was expected that the available enforcement data are scarce and that despite the extensive list of the collected data, only some data would be acquired during the collection process and that the acquired data would vary from country to country. However, the list of the collected data (that is, the questionnaire) was prepared to reflect the ideal situation with maximal data availability. The data were mainly collected from general statistics, data departments of the national and local police forces, and different ministries.

In the pilots, it turned out that the data indeed were very scarce. The lack of data was not limited to certain countries or key actors but some common problems could be identified. This significantly limited the planned analyses and options to compare countries and practices. In the following, the rough evaluation and analysis of the collected data is presented.

Legislation: Variations between the countries were found, both in regard to speeding and drink-driving. For example the speed limit on motor roads and expressways vary from 80 km/h

in Denmark to 130 km/h in the Czech Republic. Variation in relation to BAC limit concerns both the actual BAC limit and whether special BAC limits apply to selected subgroups of drivers. Variation also exists concerning Random Breath Testing and Evidential Breath Testing. Regarding restraint use (in private passenger cars) the legislation is the same in all the countries included.

National Enforcement Plans: Four of the six countries did have a National Enforcement Plan. Both similarities and differences were found across the countries.

Planned and actual enforcement activities: There was not enough information on either speeding, drink-driving or restraint use to perform any analysis.

Violations: Relatively complete information on speeding violations was available in three countries allowing for comparisons to be made. The most notable finding was the very high number of violations reported by Austria compared to the other countries even when baring into account the amount of vehicle kilometres driven in each country. A possible explanation might be found in Austria's roles as a transit country. For drink-driving a similar pattern was found. There was not enough information on restraint use to perform any analysis.

Sanctions: Some information on sanctions was available concerning speeding but not enough to estimate a sanction/violation ratio for all countries. A curious finding appeared: The Czech Republic reported more sanctions than violations. This may be explained by problems with the recording of violations. Only two countries provided information on the total number of sanctions for drink-driving: Czech Republic, where approx. 91% of the violations were sanctioned and Sweden, where only 68% of the violations resulted in sanctions¹. Once again not enough information was available on restraint use to perform any analysis.

During the data collection process, the following problems and barriers were identified and evaluated, as these might be useful for future reference:

- The level of detail of the information needed in the PEPPER project made it a challenging task to collect the data not only because of the increase in the amount of data needed but also because of the increase in the number of informants required to provide these data.
- The data needed by researchers do not always match the format in which the data are recorded by the informants and, thus, it became almost impossible to extract the precise data.
- Some data are considered confidential by some informants, who then hesitate to provide the data because they are uncertain of who will gain access to them.
- In some countries changes of legislation took place. This did in some cases influence the definitions of the data and, thus, obstructed the data collection.
- The provision of data is time consuming and it was not always possible for the informants to find the time to provide all the data needed.

¹ One possible explanation for the somewhat low rate in Sweden is that sometimes "drink-driving" is not the main offence and the statistics for persons convicted of offences only shows the main offences.

- In the PEPPER project, focus was on data at the national level. However, sometimes they only exist at a regional level, making it difficult to collect complete data.

It can be reasonably concluded that the TLE data availability in the fields of speeding, drink-driving and restraint use is at present very limited. Even among the countries with the strongest tradition for collection of traffic safety data there are major problems with delivering necessary data for even a limited overview on the status. This means that in the short run, the available data would by no means be able to fulfil the demands of the EC Recommendation (European Commission, 2004), not to mention the demands for more detailed data from scientists in the traffic safety field. On the other hand, it should be a common goal for all involved countries that these problems with data availability will be remedied over time, but it will most likely take a number of years before each country is able to deliver data that to a reasonable degree satisfies the demands from the political/administrative systems as well as from the scientists.

There are also economic considerations to take into account, as the collection of data can be a heavy burden on the involved countries and organizations, and can be in direct competition with the use of resources for other purposes that might be regarded as more important for the single authority. As demands for detailed data increase, the traditional, manual collection of data must be replaced by more automated methods, leading to a need for IT-development, which can be expensive as well as complicated. Therefore, the single country/organization might not always have the necessary incentive to focus on improved data collection, even though benefits from a more consistent knowledge of best practices in the field of TLE across the EU might be substantial. To ensure a proper development process, it is necessary to combine the technical and conceptual development process with a serious political effort to keep a common focus of the goals of this work.

However, it is considered that the conclusion should not be that a very simple data collection system is sufficient to cover the needs in the short or medium perspective, and that the development of a more advanced data collection system could be postponed to some time in the future. We believe that in order to ensure continuing increase in traffic safety, it is important that we can deliver useful output from the outset, and that the DCS has a structural design that allows for the implementation of new data and new data sources over time. Five phases in future data collection and data availability development, as well as the associated challenges are illustrated in Figure 9, and described in more detail in PEPPER D8.

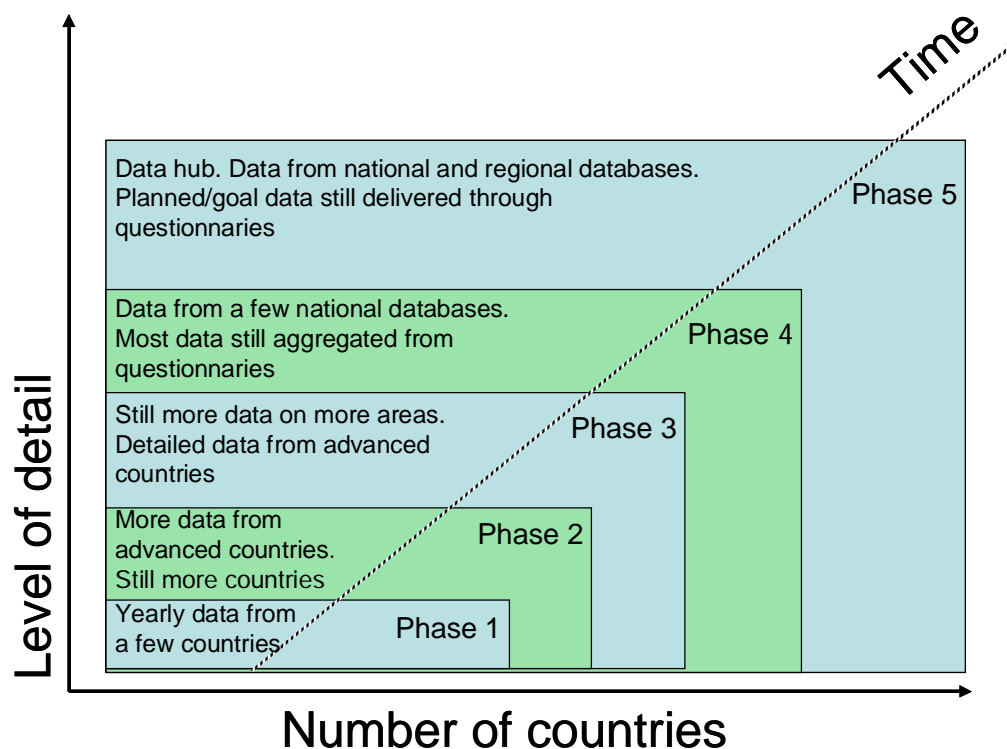


Figure 9. TLE data system development scenario.

5.4.3 The data input: conclusions

During the work performed in WP 2, it became increasingly clear that the data input process and data collection system have to meet a set of fairly high demands. A number of overall challenges, which such a system has to be able to take into consideration in a proper way, were identified. In short, they can be divided as follows:

- **Flexibility:** In line with the demands at the database level, the DCS must in the short term be able to handle very aggregated input from a very limited number of sources, in such a way that the limited amount of data can still be presented to the end user in a simple form (e.g. EPIs). At the same time, the DCS must also be able to handle more complicated data from diverse sources in a later. The DCS must also be able to handle very different organizational structures between the different countries. Development of the DCS is not done in one coherent process; it is more likely that the DCS will be under continuous development, while being in full-scale operation.
- **Data availability:** The amount and quality of data will differ from country to country, between organizational units and between the three main areas of Traffic Law Enforcement. The DCS must be able to handle data input on all these different levels, without making it unnecessarily complicated for the users to input data into the system.
- **Data aggregation levels:** The DCS must include procedures to handle data input on various levels of aggregation – and be able to handle changes in aggregation levels over time. It is vital that the system secures that output can only be produced on data that fulfils common criteria regarding aggregation levels, i.e. data from different countries must be enumerated

into one common aggregation level on the output side, even though input data is delivered on different aggregation levels.

- **Planned data/actual data:** The system must be capable of handling the input of planned as well as actual data. Planned data covers areas such as data in National Enforcement Plans, data on legislative structures etc.
- **User friendliness:** The DCS must be designed to comply with high standards regarding user friendliness. The nature of the data covered by this project makes it unavoidable that a high degree of data complexity must be handled. In order to succeed in developing a DCS capable of handling all these complex types of data, without making it very difficult for the users to input data into the system, user friendliness is probably the most vital of all the issues that should be taken into consideration.
- **Security:** Most of the TLE data are by nature sensitive data – at least when reported on a fairly disaggregated level. Handling of security issues must therefore be an integrated part of the system. Issues covered include also handling of user rights and general system security. Furthermore, certain types of data can be regarded confidential so output must be restricted to selected groups of users etc.
- **Open data structure:** The DCS structure must be open and flexible, making it possible to implement changes over time, when new types of data or new areas of Traffic Law Enforcement need to be integrated into the system. Openness must also be ensured in the form of data interfaces that makes it possible to integrate a TLE data system with other systems holding other types of data (general statistical data etc.)
- **Compliance to standards:** On the technical side it must be ensured, that the DCS is designed and implemented in a way that is compliant to relevant technical and usability standards. As an example, the use of the system should be open for as many users as possible through the use of most common browser types, possibly supplemented with a need for standard add-in tools (such as pdf document readers)
- **A platform for common definitions/terms:** There is today a lack of common understanding regarding many of the important terms and definitions in the area of TLE data. It is considered important to build tools into the DCS, which make it possible to reach common understanding of the central terminology and deliver a common interface for the users, functioning as a “TLE Wikipedia”.
- **Incentives:** Special emphasis must be given to the needs of the organizations and users responsible for delivering data to the system. If they are not convinced that they benefit from taking part in the work, data quality and data availability will be at risk.

Although the above-mentioned issues are important, and should be taken into account when developing the DCS, it possible to choose to do this with varying levels of ambition.

5.5 Database structure and functionality

The data model and the resulting physical database is the middle layer between input and output. It is here the conflicts between demands on the input side and the output side need to be resolved. This is done by designing a database structure that allows for the very detailed needs on the input side, while at the same time securing that variables and tables in the database are linked together so it is possible to present data in the right, flexible way on the output side.

Decisions on how to implement the final database model were not in the scope of the work in WP 2, but need to be taken at a later stage. When doing that, the following aspects need to be taken into consideration:

- The model must be able to handle data on very different levels of aggregation. Ideally, it must at the same time be possible to input aggregated data, where that is feasible, and very disaggregated data, e.g. data from speeding campaigns on a “single offence”-level
- Data on the same subject from different authorities might be delivered in very different forms and in different measurements. The database model must include procedures to check data quality of diverse data and transform them to a common scale, in order to be able to make use of the data on the output side.
- There must be procedures securing that data output across countries, e.g. total statistics on the EU-level, is checked for data completeness before use. For instance it must be checked that data is available from each country in a common form, if there is a need for output as EU-totals.
- Data model must from the outset be able to handle temporal and spatial dimensions on a very detailed level (as well as more aggregated measures), to be prepared for future needs for very detailed information.
- Inside the database there must be procedures for calculating a great number of supplementary variables, for instance based on combinations of input data and external, statistical data.

A preliminary data model defined in PEPPER D8 suggests how the TLE database could be organized. The preliminary model was not supposed to be a complete description of the model in all details, including all tables, variables and relationships, but all major issues and connections between different types of data were taken into consideration. Focus areas of the PEPPER project are defined as speeding, drink-driving, and restraint-use. However, an open structure was modelled in which it is fairly easy to implement new elements, if necessary.

There are certain specific issues in collecting and reporting TLE data (e.g., the substantial difference in the amount of data available and their level of detail in the different Member States, the difference between data availability now and data availability in the future, the different needs on the output side between authorities (the more aggregated reporting) and researchers (more detailed analysis)). These issues have an impact on how the data model is being conceived. This could be summarised as follows:

- The model has to be flexible, and it must be easy to incorporate new “areas” of data.
- The model has to be able to handle issues concerning different levels of detail (data granularity).

- Certain security issues have to be considered, especially when dealing with the future scenario, where data are imported from databases on a “single offence”-level.

The above points have led to the overall model that can be illustrated as in Figure 10.

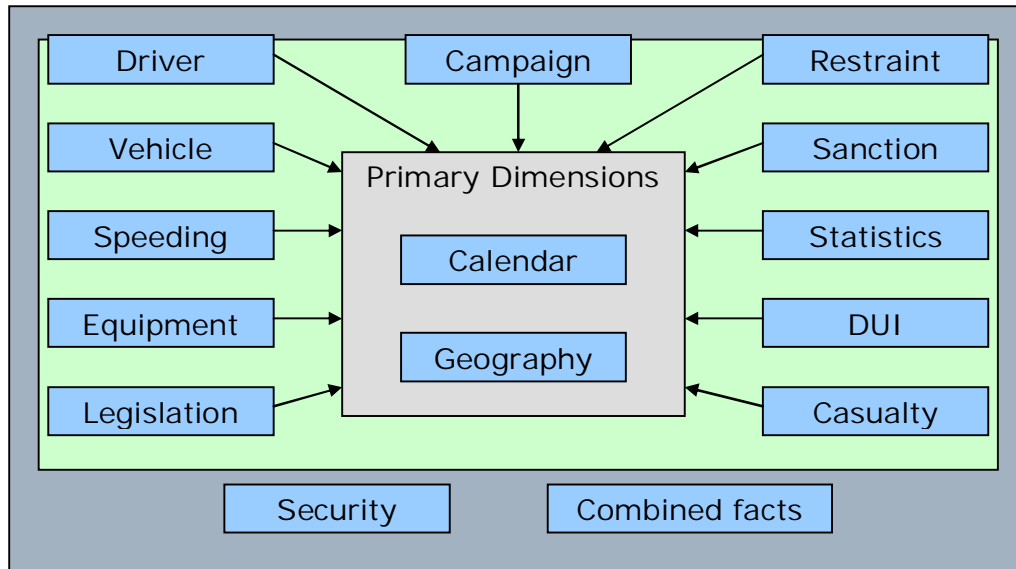


Figure 10. Overview of data model elements.

The light grey area consists of the two primary dimensions: Temporal (Calendar) and spatial (Geography), which ties the different parts of the model together.

The green area consists of all the different areas that are analysed. The reason for splitting the model into these many different parts is an attempt to facilitate the easiest possible input of data into the model. It was instead chosen to make the tables “broader”, incorporating data from different areas into one table; this would have made the model less flexible concerning future changes. It would also make it much more difficult to input and use data, where a combination of information from different areas is necessary. The actual variables to be collected can be defined according to the needs and prioritizations. One suggestion for the core variables has been given in form of EPIs (see also chapter 7) but these might change with time and variations in the traffic safety situation.

The dark grey area consists of the security and “combined facts” areas. Whereas the security area is self-explanatory, the “combined facts” area is used to combine information across areas. An example could be an analysis of how many speeding infringements also included a DUI (driving under influence) infringement. In this case, the “combined facts” area is used to extract data on cases that include information on both DUI and speeding.

The more detailed description of the structure of the model can be found in PEPPER D8.

5.6 Practical considerations related to the database

5.6.1 Steps towards a European wide database

There are some practical steps to be taken, if the European wide TLE database is to be established. First, the different phases in database system development should be understood (Figure 11). While the work of PEPPER has focused on the level of a conceptual model, in the later phases IT-professionals are needed.

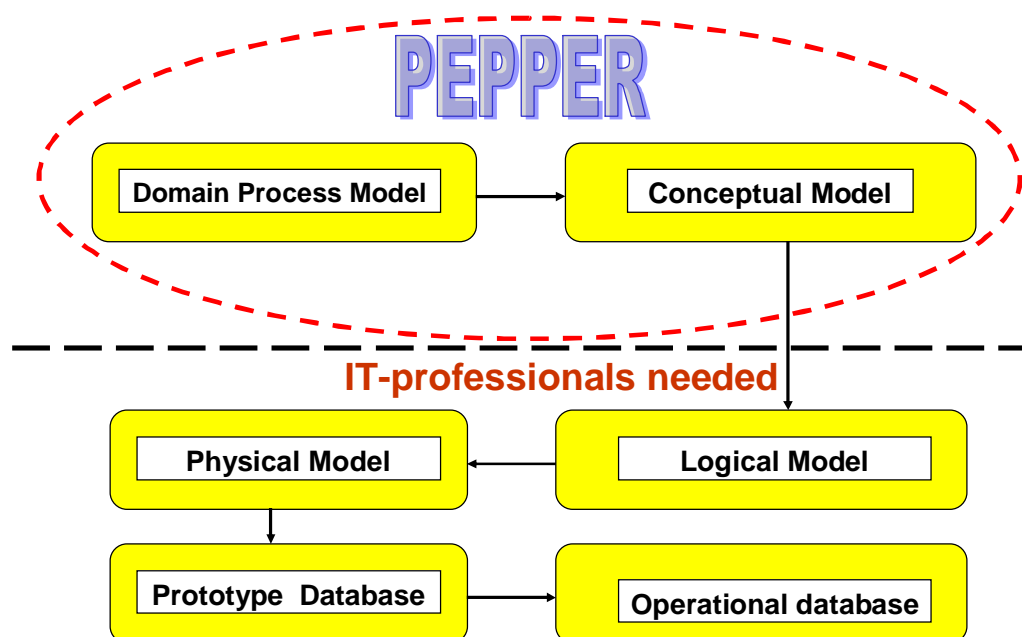


Figure 11. Phases in database system development.

Second, certain issues regarding system administration and data security need to be thought through before establishing the database. These issues will be described in more detail in the following.

5.6.2 System administration

Setting up a DCS and a DB capable of collecting and organizing data on a European wide basis, with fragmented data delivery and country-specific structure requires a well organized system administration. This is the case with respect to the administration procedures available in the DCS/DB, and just as well the practical organizational setup and the people who are given the task of handling the system administration. If this is not handled on a high level of quality, it is very likely that the credibility of the system will be severely reduced.

Organization: One central authority at EU-level should be responsible of running and developing the DCS and the DB (and output delivery tools). This authority should also be responsible for handling user roles and rights as well as system security issues. However, it is not likely, that one authority on the EU-level will be able to keep a full overview of how data collection must be handled inside each country and which authorities are responsible for the single parts of data delivery. Therefore system administration must be handled in two or more

“layers” where administrative rights are delegated from the top level to a more locally based authority. It is important that the delegation of administrative rights is followed up by a system of checks and balances, where the authorities on different levels keep each other informed on the status of administrative matters.

User roles: The system must have a fairly advanced set of rules defining which questions the different authorities have to answer. These rules shall be able to handle differences in organizational structures etc. from country to country on a single question level. This must be done by defining different user roles which, in combination with identification of the authority in charge of delivering each single piece of data and identification of the single user, would make it possible to identify which entity shall deliver a certain information and who has actually done it (for follow up purposes and quality assurance).

The hierarchy of user roles can be defined in many ways, but a preliminary suggestion could be the following: top level administrator, national administrator, local administrator, data provider, data validator, and data viewer; with each level having its own specific set of user rights.

5.6.3 Data security and confidentiality

Data security is an important issue to be taken into consideration when designing the DCS. Data security is generally handled through the use of the different user roles.

There might be also issues on data confidentiality to be considered. Even though data on a certain subject is actually available, the authority responsible for the data may be unwilling to report these data to a common database or other system due to confidentiality issues. It is therefore important to have a set of built-in mechanisms in the DCS/DB which can make sure that confidential data are treated in the right way.

One solution could be to apply the following rules:

- A certain type of data or a certain result is permanently made unavailable for one or more groups of users (e.g. general public, users outside specific countries or users outside specific organizations etc.).
- Data is entered into the system, but is in a certain period of time for restricted use only.
- Data is entered into the system, but must only be available to certain groups on specific levels of aggregation.
- Data is entered into the system, but shall always be aggregated before use. This could be the case with very detailed data from national databases, automatic enforcement equipment and statistical databases with data on an individual level etc.

If TLE DCS/DB is to have the needed credibility among its core users, it is important that these rules can be applied and will be handled properly.

5.7 Conclusions

1. A conceptual model for European TLE database was outlined and consists of three main elements of the data chain: input, system and output, which are closely interconnected. On the output side the focus is on presenting well-defined, structured data, typically originating from a number of different sources. On the input side the focus lies on how to support data collection on a single question and single user level, and input data is typically more disaggregated than the output data. The system in-between takes care of the storage and modification of data so that the desired links between input and output can be realised.
2. Regarding output from the envisaged database, the data listed in the Commission Recommendation on Enforcement (European Commission, 2004) would probably fulfil most needs. However, a survey of the needs of national and regional authorities and other (research) organisations should be conducted to make sure that the database would be useful to all relevant needs.
3. Input to the database should contain quantitative information on planned and actual enforcement activities e.g. by enforcement target and method the number of checked vehicles, number of detected violations and issued sanctions.
4. Regarding input to the database, a survey in four Member States revealed there are large variations between countries in the availability of enforcement data, and that in general only little information is available. Data either does not exist or are considered confidential. Furthermore, the data have to be collected from several sources and are often stored in different formats and media.
5. The database should be capable of handling differences in legislation, sanctions and the organisation of police enforcement forces between Member States.
6. For the evaluation of the effects of enforcement and other scientific needs, it is essential that data from the database can be extracted also on a disaggregate level.

6. INNOVATIVE TECHNOLOGIES AND APPROACHES FOR IMPROVING COMPLIANCE WITH TRAFFIC LAWS

The results presented in this chapter are based on PEPPER deliverables 1, 3, 10 and 11

6.1 Introduction

Technology could change the nature of enforcement from primarily detection and punishment, to more prevention and self-regulation by traffic participants. Sensing, identification, location, communication, and processing technologies could assist Traffic Law Enforcement (TLE) in monitoring traffic behaviour and automatically warn or apply sanctions to offending traffic participants. Traffic surveillance and in-vehicle technologies may enable embedding of TLE elements into the routines of traffic management and in-car telematics, focussing on compliance rather than enforcement (e.g. ADAS, Speed Alert and ISA). In assessing the possible application of innovative technology and the new approaches it may open to TLE, including cross-border Traffic Law Enforcement, consideration will be given to potential integration and implication of innovative technology across the enforcement chain. Another aspect that is to be focussed on is the cross-reference between the different technologies: in-car, vehicle-vehicle, vehicle-road etc. The deployment of enforcement technology also requires a good administrative follow up. This part of PEPPER has 4 subtasks:

- IT tools for monitoring traffic, vehicles and drivers.
- Implications of innovative technology for the key areas in traffic safety: speed, drink-driving and restraint systems.
- Conceptual model for using positioning technologies in the tactical planning and deployment of traffic surveillance and Traffic Law Enforcement.
- Implications of new technologies for European cross-border Traffic Law Enforcement.

6.2 Innovative technology for monitoring traffic, vehicles, and drivers

This task produced an overview of the most relevant enforcement technologies and systems used today and the potentialities envisaged for those to be deployed in the near future. Special emphasis was given to open up the possibility of relying on information systems that have the potential to achieve more self-compliance with traffic regulations by means of these systems. The technology developed at EU level was presented in two main categories:

- ‘Active enforcement’ in accordance with the enforcement chain. This refers to the technology used by official Police agencies of a state (national, regional or local) or by private / commercial entities delegated specific enforcement powers and operating under political supervision of the Government. This type of enforcement is repressive by nature, laid upon a motorist beyond his/her control. This domain is strictly governed by laws, laying down strict rules on type approval and certification of technical devices that have to measure values in relation to the violation.

- Warning/monitoring and control /surveillance technologies (later on in the project referred to as “passive enforcement”) that are being developed and brought to the market by the industry with the aim to enhance road safety by informing and thus supporting the driver in the driving task. This technology does not always address enforcement in the first place but has the potential to inform and/or support the motorist to drive safely and in compliance with the traffic regulations. It has no punitive impacts and is voluntarily in nature.

6.2.1 Developments in active speed enforcement technologies

Speed enforcement across Europe is quite well established; as the VERA1 project pointed out, automated speed enforcement is allowed by law in all EU Member States. Specific Camera safety programs have been established in several Member States as well, notably the UK Speed Camera program and the French automated speed enforcement program, introduced in 2003, have become quite known. Latest development is the application of average speed enforcement systems (also known as section control enforcement systems), measuring the average speed on a stretch of road. These systems are already operational in the Netherlands, Italy and in Austria. Austria specifically applies section control in their tunnels; this has improved tunnel and road safety quite considerably. It is piloted in the UK, France, and Spain. Other Member States that have plans to take up average speed enforcement are Belgium and Switzerland (putting the priority first on tunnel safety as well).

Spot Speed enforcement

Spot speed automated enforcement systems have been used to record speeding in several countries for quite a long time, and are still widely used. In recent times, development of digital cameras has led to a progressive substitution of the film cameras traditionally used for enforcement for the newer digital devices. Surveys carried out in several countries show the acceptance of measures to enforce speed limits, speed cameras among them, to be high. Over 70% of the Norwegian population is favourable to the measure, percentage being almost 65% in the case of Spain and similar in other European countries.

Section control automated speed enforcement

In the mid 90s, a number of Member States started trials of a new speed enforcement system. The new system was based on the simple idea of checking the precise moment when a car entered a given road section and the moment when it left it, and with the time it took the car to make the (known) distance, to calculate the average speed the car had been driving at. If this average speed was above the limit, enforcement follow up was to be engaged.

Cameras installed at gantries at the entry and the exit of a given road section of several kilometres take pictures of the vehicles going in and out of the section, and of the vehicle's licence plate (Figure 12). Along with other information such as a data- and timestamp, an electronic file is generated with a so called *digital fingerprint*, and managed also by cameras' accompanying equipment, ensuring that each file is unique and secure. A processing unit checks also constantly for licence matches from both sources – entry and exit cameras. Whenever a match is found, the average speed of that car is calculated. If this calculated average speed is above the limit, the image of the licence plate is sent to the traffic authorities for identification purposes of the owner of the vehicle, after which police authorities execute

the regular enforcement process and take care of the administrative or legal follow up procedures.

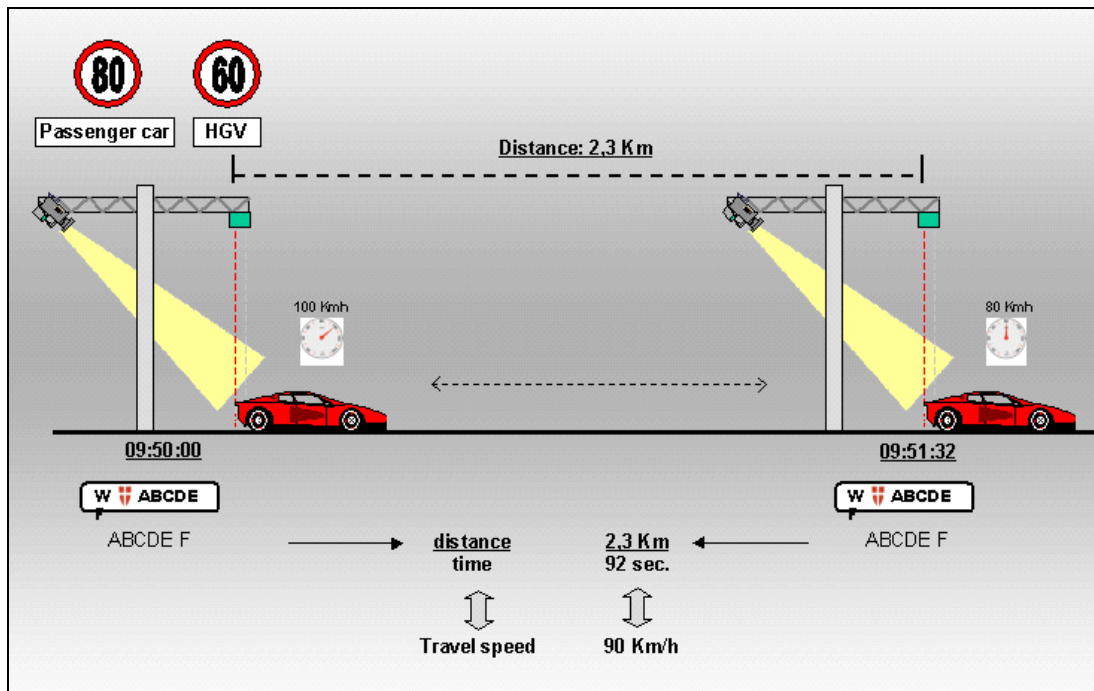


Figure 12. Typical section control architecture.

Future possibilities of section control

The technical advances in computing in the last years have had their consequences in digital video technologies too, opening a completely new range of possibilities and applications in many fields, and enforcement is no exception. Once the physical video enforcement infrastructure is installed, implementing uses other than speed enforcement requires probably just a proper software application development. Pilots have already started for seat belt (see chapter 6.2.3) and tailgating infractions. Planned future applications include infractions such as the tracking and tracing of suspicious or stolen cars, vehicle weight infractions, road-use related infractions, overtaking infractions, improper lighting use and detection of dangerous driving patterns.

Legal issues

In several European countries it is the driver of the car who is held fully responsible if a speeding violation occurs, not the owner of the vehicle. Because of this, in the countries where such legislation applies, the photos must have a high quality, making it possible to both identify the driver and the registration number of the vehicle. It is the owner of the vehicle that is contacted if a speeding violation is registered. If the driver cannot be identified by means of the picture or if the owner cannot (or refuses to) identify who was driving the car, the charges are usually dropped. Additionally, it is not allowed to keep identifiable pictures of passengers occupying the vehicle. This poses a barrier to efficient deployment of automated speed enforcement systems, especially if it concerns citizens from another Member State. At the same time, this will put a huge burden in terms of labour costs on police agencies. Tracking

down and identifying the driver is a labour intensive process, which is totally avoided if the registered owner/keeper can be held responsible by law.

6.2.2 Developments in active drink-driving enforcement technologies

EU Member States all use screening and evidence devices for the determination of the BAC. These devices are adapted or adaptable for the various BAC limits in the EU and have to be type approved for each Member State and calibrated before they can be used in operational traffic policing. Technology developments are applicable to these devices as well, but are not to be considered to be ITS specific. In some countries, police are allowed to control and test drivers randomly. Suspicion of an offence is not necessary for testing. Several countries, however, treat any roadside testing procedure as an intrusion into personal rights which can only be done if an initial suspicion exists.

6.2.3 Developments in active seat belt enforcement

The seat belt is the single most important safety feature in the car. In fact, most other safety features in a car are based on the premise that a seat belt is being used. Despite EU legislation that mandates the use of seat belts, wearing rates vary considerably within the EU Member States, averaging 76% for front seat occupants, and 46% for rear seat occupants (ETSC, 2003). Belt use in accidents is significantly lower. Approximately 15,200 road fatalities did not use seat belts.

If the belt use could be increased to 100% approximately 7,600 lives could be saved (ETSC, 2003). At the moment there is no specific ITS technology or technology development for the automated detection of seat belt compliance used in any Member State. Automatic seat belt enforcement using digital cameras was tested by VTT in Finland.

VTT pilot project on automated detection of seat belts

The aim of an automated seat belt detection pilot was to find out if the seat belt detection could be automated using innovative technologies. The project examined camera and shooting parameters, estimated detection success, and cost of a real system. After measuring the angles of about 30 different windscreens and the corresponding maximum camera angles it was found that the maximum camera angle should not be more than 15 degrees from the ground level in order to see the seat belts in different types of vehicles. In the test situation the camera could not be lifted up higher than 5 meters. The height of 5 meters and the angle of 15 degrees meant about 12 meters distance from the camera to the car's buffer as shown in Figure 13.

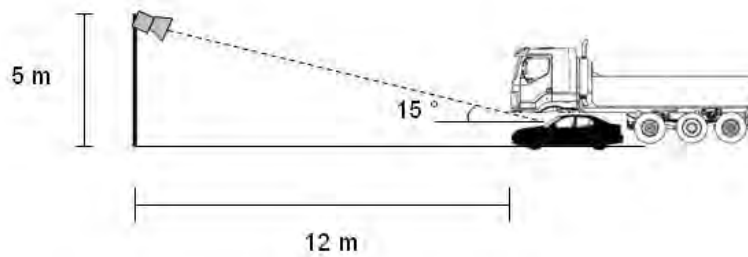


Figure 13. Camera parameters used in the pilot and the optimal camera angle

After having the proper imaging circumstances 11 drivers with different types of vehicles were photographed. Zooming and having extra light from the side was applied for image enhancement. First the images were converted from colour to gray scale images. Then a histogram analysis was performed for the regions of interest (seat belt area and areas near the seat belt) and also the mean gray value and its standard deviation was calculated.

Among the 11 vehicles tested, in 10 cases the differences of mean gray values between seat belt and background were big enough for the detection of seat from images. As an exception, when seat belt was beige and driver's clothing nearly the same, the seat belt was quite well visible in images but could not be detected automatically. For unclear or negative results, further semi-automatic processing can be performed. In such cases image processing can assist the human operator. For example, in cases where the histogram analysis provides an unclear resolution where the average gray level difference is less than 15, the image can be thresholded to binary image by setting the threshold value in between the two histogram peak values (Figures 14 and 15). At this pilot the success of automatic detection was about 83%.



Figure 14. Original picture, seat belt is not visible.



Figure 15. Binary thresholding, seat belt is visible.

6.2.4 Developments in passive speed enforcement technologies

Adaptive Cruise Control (ACC)

Adaptive cruise control (ACC) enhances classical cruise control and, additionally, will maintain a proper following distance to the preceding vehicle. The distance to the preceding vehicle is measured by radar either with laser radar or millimetre wave radar. When the vehicle ahead is driving more slowly than the adjusted speed, the ACC system will control the vehicle speed and follow the lead vehicle at a safe distance.

Once the road ahead is clear again, the ACC will accelerate the vehicle back to the previous set cruising speed. ACC, including Stop & Go, is generally regarded as a comfort function that helps and assists a driver to fulfil his/her longitudinal driving task. In terms of compliance with traffic regulations, there is a great benefit to reap: ACC will simply prevent tailgating, one of the most prominent and annoying violations on motorways.

Intelligent Speed Adaptation (ISA)

Intelligent Speed Adaptation (ISA) is a concept that has been evolving along the years since it was first conceived some 15 years ago. ISA is a group of functionalities with the aim of providing the driver with assistance to comply with the required speed limits. The lack of clear ISA specifications has caused that basically two types of ISA have been developed:

1. *Warning* or *Informative* when the ISA in-vehicle device just gives the driver information of whether the speed limit has been surpassed, and additionally of what was the speed limit applicable; here the system interacts with the driver only.
2. *Active* when the ISA in-vehicle device incorporates means of physically interfering with the car's engine or accelerator to effectively prevent the car driving above the limits, or at least to make it difficult; here the system interacts with the car.

A combination of both technologies is possible as well. In order for the ISA system to be able to determine the appropriate legal speed, it must know the time and position of the vehicle and what speed limits apply at different locations and possibly times. This usually requires a positioning system that will be accurate enough (GPS/GALILEO), a digital map and database with the actual legal speed limits and software that matches the positions on the map and finds the legal speed limit at the location and time in question.

In general, it can be said that the expected positive effects were confirmed and even reinforced, while the results are mixed with regard to the non-effects or negative effects. Evaluations show that it is reasonable to believe that road safety will improve significantly by ISA. If every car would be ISA equipped, there could be 20% fewer road injuries in urban areas. The average speed on stretches of road has clearly fallen with ISA. ISA vehicles drive more homogeneously and with fewer peaks in their speed. Pedestrian awareness has increased in the wake of this too. Travelling times in urban areas remain unchanged despite lower driving speeds in specific areas. The explanation is because there is less stopping and fewer braking situations with ISA. Road-users experience travelling times as unchanged or marginally longer. Acceptance of ISA in urban areas is high.

6.2.5 Developments in passive drink-driving enforcement technologies

Alcohol interlocks could form part of a solution to reduce the problem of drink-driving. An alcoholock, or more formally: a “breath alcohol ignition interlock device” (BAIID), is fitted to a car’s ignition. It prevents the starting of the vehicle if the breath alcohol concentration exceeds a predetermined threshold level. The threshold can also be set at different levels depending on the particular alcohol limit suited to the different drivers. The system analyses the driver’s breath while driving. If the alcohol concentration is over the legal limit the driver has a few minutes to park the vehicle before the engine stops.



There are two distinct areas in which alcohollocks may be used: as a preventive measure or as ordered by a court. Installing an interlock as a preventive measure in transport vehicles such as hazardous goods transporters, lorries, coaches and taxis can reduce accident risk. The second area in which alcohollocks are used is when a court or other authority orders an alcohollock to be installed in the vehicles of drivers who have a history of offences due to driving under the influence of alcohol.

Alcohol inter-locks have been used in Sweden and Finland by drivers who were given the choice to install the device in their vehicles or face driving license suspension. In Sweden, the participants in the study had a high risk of recidivism and ran a four times higher risk of being involved in an accident than the average driver. After two years of use there was still no recidivism by the participants of the test group.

6.2.6 Developments in passive seat belt enforcement technologies

Seat belt reminders are devices that send out a light and/or sound signal to alert the car occupant that he or she is not belted up. There are different types of seat belt reminders – some are just visual warnings while others are using both visual and auditory warnings. Many new vehicles are now fitted with such devices. Seat belt reminders have been developed for all seating positions in the car, but are to date most commonly fitted only for the driver seat or for both front seats. Field trials in the USA, Australia and in Europe have proven that seat belt reminders ensure that the occupant uses the seat belt more frequently. A Swedish study shows that the seat belt wearing rate was 99% in cars fitted with seat belt reminders that fulfil the EuroNCAP specification (Folksam, 2005). If the automotive industry at large should decide to

develop and to put into cars a system that prevents the starting of the engine unless at least the seat belt of the driver is fastened properly, the number of road accident fatalities would be significantly reduced.

6.2.7 Cooperative Systems

Cooperative systems include: forward collision warning, reverse collision warning, lane keeping devices, night vision enhancement, drowsiness and fatigue warning systems and autonomous/adaptive cruise control (PEPPER D1). In the following the focus will be on the cooperative systems that have a huge potential to enhance compliance with traffic regulations and to promote large-scale self compliance.

CALM/cooperative systems

To rely on more flexible architectures that can support different media and thus provide a much wider range of possibilities and flows of information for different systems, CALM (*Continuous Air-interface Long and Medium range technologies*) is being developed. Alongside with the development of this CALM architecture it is envisaged that the potential to give support to Intelligent Co-operative Systems will be based on Vehicle-to-Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications. These intelligent Cooperative Systems will increase the "time horizon", the quality and reliability of information available to the drivers about their immediate environment, the other vehicles, and road users, enabling improved driving conditions and thus leading to enhanced safety, mobility efficiency and a more traffic law compliant behaviour. Deployment of enforcement within ITS architecture using communications V2V (GNSS/CN, Wi-Fi), and V2I would significantly improve compliance with traffic regulations (maximizing efficiency). This potential for the use of some specific systems and tools to resolve a particular enforcement step, the evaluation of the impact they might have after implementation and installation should be an issue to consider. Legal frameworks, privacy issues, user acceptance, type approval of enforcement equipment, specification of data for describing the event, certification, interoperability, cross-border implementations, benefits after implementation and collateral effects (cost-effectiveness, mobility, environmental aspects) are issues to be considered and analysed in more detail.

CALM enabled safety services list among other things: Curve Speed Warning - External Speed Limitation - Speed Limit Advisory - Speed Limit Control - Blind Merge Warning - Emergency Vehicle Signal Pre-emption - Highway/Rail Collision Warning - Infrastructure Intersection Collision Warning - Pedestrian Crossing Information - Pedestrian/Children Warning - Road Condition Warning - School Zone Warning - Sign information (warning assistance) - Intelligent Traffic Lights - Intersection Collision : Vehicle-Based Warning - Stop Sign Warning - Traffic Signal Warning -Work Zone Warning - Wrong-way Driver Warning - Approaching Emergency Vehicle Warning - Cooperative Adaptive Cruise Control - Cooperative Collision Warning - Crash Warning.

It is not difficult to see where this may help to achieve better self-compliance with traffic regulations.

6.3 Implications of Innovative Technology for the Key Areas in Traffic Safety: Speed, Drink-driving and Restraint Systems

A broad overview of the most relevant enforcement technologies and systems used today and the potentialities envisaged for those to be deployed in the near future, mostly from a safety point of view but also taking into consideration mobility, security, and environmental improvements, is described in section 6.2. Even though some of the enforcement technologies described there have been proved to have a positive effect on safety, the legal/jurisdictional requirements and socio-political contexts often constitute a significant refrain to their deployment. A serious effort has to be made by EU enforcement authorities in order to provide a clear and stable legal framework, plus clear type approval guidelines in which development and implementation of new enforcement technologies can be swift and smooth among all Member States. In the following enforcement approaches are classified as active or passive.

6.3.1 Implications of Active Enforcement Systems

Section control

In the Netherlands and France there has been about 30% less traffic deaths and lower degrees of speed violations after introducing section control (described in detail in section 6.2). Whereas traditional fixed point cameras have been suspected to enhance driver inattention, the new system of section controls does not seem to cause this at all; as far as known, no scientific research on this has been carried out yet.

Obstacles to wider implementation of section control include issues of driver vs. owner/keeper responsibility, protection of privacy (Norway and Switzerland) and type approval.

Effects on speed

Studies in Austria and The Netherlands demonstrated the effect of section control on speed. Shortly after installing section control at the Kaisermühlen tunnel a reduction in average speed by 10 km/h or more was recorded (Table 2). After six months average speed on this road section has levelled of to 75 km/h (Stefan, 2006).

Table 2. Average speed of vehicles before and after section control installation (Stefan, 2006).

	Passenger cars		HGV	
	Before	After	Before	After
Daytime	85 km/h	75 km/h	70 km/h	55 km/h
Nighttimes	95 km/h	75 km/h	75 km/h	55 km/h

Essentially similar results were reported in the Netherlands, where section control was introduced many years earlier.

Effects on accidents

A detailed study of the Austrian section control implementation (Stefan, 2006), in which a thorough analysis was carried out of data on accidents and accident severity, shows that the number of fatal and serious injury accidents over two years was almost halved (Table 3).

Table 3. Safety effects of section control on accidents and accident injuries (Stefan, 2006)

	Odds ratio	Safety effect [%]
Injury accidents	0.67	-33.3
Fatal and serious injuries	0.51	-48.8
Slightly injured	0.68	-32.2

Environmental benefit of reduced speeds

For the Kaisermühlen Tunnel, the lower average speed due to Section Control is estimated to have resulted in more than 12,000 tons of saved CO₂ emissions, having a discounted monetary value of more than €280,000.

Seat belts

Automated seat belt enforcement (a Finnish pilot study) most likely reduces the frequency of violations. Protection of privacy might be an obstacle (possibly in some countries). It is hard to estimate the detection success of a real system. Comparing to traditional police enforcement automatic enforcement system operates 24h/day tirelessly and without any gap, except only out of order situations. According to the Finnish pilot study, it seems that the detection success of an automatic system can be very close to the situation of visual detection. When the seat belt use is visible to the eye it is very likely that it can also be detected automatically.

Black box recording of seat belt usage could be used as an enforcement tool, although it would be reasonably easy for a determined driver to fool the system into believing a seat belt is being used when it is not. Commercial devices exist (Schmidt-Cotta et al. 2006) which record a number of parameters like speed, excessive acceleration and braking, seat belt usage etc. While these are marketed primarily at concerned parents who want to monitor the way other family members use their cars, some of this functionality is likely to be used in future black boxes.

6.3.2 Certification procedure in accordance with EU Type Approval

Trust will be an inherent part of traffic law and cross-border enforcement. Trust in this context means each Member State accepting another Member States' record of a violation, accepting their processing of the record and accepting the results of their prosecution process. A common basis for type approval will ensure this trust and that records of every violation are made on a common basis that can be accepted by all Member States. Many Member States have existing type approval requirements and support networks to carry out type testing and approval of enforcement equipment and processes. However, as they are based on national legal and operational requirements and have been developed to take into account specific national operating conditions, there are inevitable differences. Where present, commonalities in

national requirements are not always transparent. A European type approval for such systems would be very helpful for manufacturers (identical design and only one type test for all countries), users (exchange of experience with authorities from other countries and easy exchange of data from country to country), and offenders.

In identifying opportunities for a common basis for type approval, the VERA2 project (Jaeger et al. 2004) adopted the following approach:

- Harmonise technical aspects of type approval (where possible) on the basis of the Measuring Instruments Directive (MID) as a common European legal framework and existing European and international standards
- Take account of the key differences between existing type approval processes where they are required to satisfy state-specific legal and operational conditions (for example, differences in driver/owner responsibility)
- Make any state-specific requirements transparent and easy-to-understand from a technical and organisational perspective.

Measuring Instruments Directive (MID)

The Measuring Instruments Directive² (MID) is a European Directive regulating the construction and certification procedures of several types of measuring instruments in order to improve free trade of these devices in Europe. The MID required agreement of European Parliament and European Council. It needed more than 10 years starting from the first ideas to finalisation. It was published on 30 April 2004 with the condition that it would not be applied until after 30 October 2006. Another condition was that the transition period will be 10 years. National implementations of the legislation are currently being worked out. The MID does not regulate construction and certification procedures of speed enforcement systems. The great advantage for cross-border Traffic Law Enforcement, however, is that all countries will have a very similar legal framework, which is an excellent basis for a transparent implementing of identical - or differing - requirements for speed enforcement systems on a national level.

To prepare such national legislation for speed enforcement systems using digital images VERA2 has drafted a separate - virtual - specific annex MI-DIMES.

6.3.3 Implications of Passive Enforcement Systems

Intelligent Speed Adaptation

There is a majority support for ISA technologies (results from studies in Sweden). ISA will reduce the need for traditional police enforcement of speed limits and replace costly physical measures currently used to obtain speed compliance. Another advantage of ISA is that the cost-benefit ratio will outclass any other means to enforce existing speed limits. The benefits are better compliance with speed limits and improved traffic flow. ISA is less repressive and reduces frequency of violations, and speed reduction is observed. There are some obstacles that

² Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments.

have to be addressed before implementation of the system, and they are: Costs of in-car and infrastructure equipment, and accurate speed limit databases.

Drink-driving

Alcolocks prevent recidivism on drink driving and reduce frequency of violations. Possible detrimental effects are fraud (e.g. driver makes someone else blow into the alcolock) and costs. High costs can prevent people from installing the alcolock because they find it too expensive. Costs are also mentioned as an obstacle, as well as legal issues (laws will have to be adapted to implement alcolock mandatory after a court decision or to install alcolocks in specific categories of vehicles like commercial lorries and busses) and different national BAC levels. Acceptance of these devices was quite high in tests and pilots conducted (Sweden, Norway, UK, USA).

Black box technology for speed, drink-driving and restraint systems enforcement reduces frequency of violations. Black box for drink-driving and restraint systems enforcement may result in driver resistance and legal issues are considered to be an obstacle for black box drink-driving enforcement.

Seat belts

Seat belt warning informs the driver of non-use, but the warning can be ignored by drivers/passengers. The effectiveness is also limited by the fact that car manufacturers seem reluctant to combine seat belt warning with ignition interlock. Automated enforcement on seat belts while driving (see section 6.2) could improve compliance with seat belt regulations.

In- vehicle Self Regulation Compliance System (SRCS)

An alternative approach for increasing compliance on the roads would be to use systems (devices, tools, and methods) that have a generalised influence on drivers to consciously adapt their driving behaviour in such way that it is compliant with the law and good / safe driving practices. Such systems could be named as “*Self Regulation Compliance System*” or SRCS. The CALM/Cooperative architectures described in section 6.2 can be regarded as such systems. Additional systems to be integrated into an SRCS concept could be: alcolock, seatbelts-fastened-dependent ignition and feedback systems that gather data continuously and present a Red – Yellow – Green profile and feedback to the specific driver/user of a such-equipped car. This has been tested successfully in Israel (Lotan, 2008).

6.3.4 Conclusions on implications and Future Work

Legal frameworks, privacy issues, user acceptance, type approval of enforcement equipment, specification of data for describing the event, certification, interoperability, cross-border implementations, benefits after implementation and collateral effects (cost-effectiveness, mobility, environmental aspects) are issues still to be given further treatment in order to promote real deployments in any Member State.

Technological availability in communication systems and digital video field exists. Such systems can either be included as part of road infrastructures or as part of smart vehicles. There are quite a number of functions and applications and each of those gives solution to different,

although usually closely linked, purposes for which the difference sometimes is only a question of requirements and lack of cooperation between main stakeholders. The objectives are quite clear and connected as well: those are safety, cost-effectiveness, mobility, security, environment, and even intermodality if traffic management is properly considered in this framework of information/warning and support, monitoring/surveillance and enforcement.

Alongside with that, the issues that have to be resolved in the near future are the following:

- The specification of an adequate standardisation framework that allows the interoperability of technologies in different contexts and countries.
- The integration in the architecture provided by CALM (communication media).
- In the specific context of Traffic Law Enforcement, type approval of equipment used for automated enforcement and description of data that univocally describes the potential offence in order to give it validity in any Member State should be rolled out in the entire European Union in the near future.
- The automation of enforcement measures has the potential of improving considerably cost-efficiency in terms of operation, effect and efficiency, human resources, and socio-economic issues.
- For driver support/monitoring systems the importance of user needs and acceptability should be a priority in the design of tools. Training and warning to the drivers might increase this considerably. Combining Driver Support Systems, Cooperative systems and Self Regulation Compliance Systems would unlock a vast potential to enhance far better compliance with traffic regulations. This should be a key item for further research and development, also taking into account to what extent this could be a substitution of active Traffic Law Enforcement, thus allowing valuable public resources to be shifted to other areas of law enforcement and crime prevention.
- Cooperation might be the key towards this safety and mobility goal fixed by the EC in European roads. This would promote that systems are put into operation.
- As a final conclusion and idea for next steps: further research must be performed in an overall framework in relation with the following issues:
 - Time critical applications,
 - Mechanisms for safe and secure application management
 - Deployment related issues (organisation issues)

To sum up, it is important at least to put into operation automated systems that are not too complicated but guarantee the requirements and quality expected in order to be able to perform studies on the real impact on safety and establish the guidelines for best practises and solutions to be promoted and deployed in any Member States.

6.4 Use of positioning technologies in traffic surveillance and Traffic Law Enforcement

Four focus areas for the conceptual model for using positioning technologies for traffic surveillance and Traffic Law Enforcement were selected: city centre circulation permission,

speeding, parking area permission and one-way road violation. For these application areas, relevant existing applications were identified and will be described in the following. Moreover, preliminary system architecture was proposed, defining the equipment needs and the flow of data from detecting the violation, to identifying the vehicle that has committed it and issuing the fine. The risks that the implementation of this kind of applications would imply were identified and ranked, using the FMEA methodology. Four categories of risks have been included: behavioural, technical, legal, and organisational risks. Finally, a conceptual model was defined, indicating the necessary steps to be taken for the effective deployment of the positioning and location technologies in traffic surveillance and enforcement. The main involved actors have been identified and their roles and responsibilities have been preliminary defined.

6.4.1 City Centre Circulation Permission

City centre circulation permission is the most popular application of congestion charging. The aim of congestion charging is to charge a price sufficiently high to promote modal shift and achieve transport policy objectives such as reducing congestion and encouraging a shift to public transport. Vehicles are charged when they cross a cordon on the outskirts of the city or travelling through a series of zones within the city.

Cordon pricing – Singapore introduced the first pricing system of this kind in 1975 using daily charges, shifting to a fully automated electronic charging system in 1998. In 2003, a cordon pricing system was introduced in London, followed by a similar scheme applied as a 6-month trial in Stockholm in 2006. The use of electronic road pricing is advisable as cordon-based charging requires electronic checking of vehicles as they cross cordons or screen lines and the automatic identification of vehicles which do not have required permits. Such a system is particularly useful where the local authority wishes to vary the charge between different times of day (e.g. charging more at peak hours).

Area-wide charges – per-mile charges on all roads within an area that may vary by level of congestion. A pricing scheme involving per-mile charges is currently tested in Oregon, USA. Such system will be considered as a replacement for fuel taxes in the future. A congestion pricing component is being tested with higher charges during congested periods on high traffic road segments.

6.4.2 Speed enforcement

The prime example of using positioning technologies in Traffic Law Enforcement is Section Control (see section 6.2.1 and 6.3.1) where the distance between 2 fixed locations (which may vary) is covered and the time is measured of vehicles travelling that distance. From this the average speed can be calculated and if above a set threshold, enforcement will be applied. A more passive way of speed enforcement is ISA (see sections 6.2.4 and 6.3.3), where the actual speed limit is presented to the driver by means of information or by interaction with the vehicle (haptic throttle), and dependent of the location of the vehicle.

A third option using positioning technologies for again a form of passive speed enforcement is the use of pocket PC's (Figure 16). These kinds of systems have been tested in Sweden and

Finland, they continuously presents the current speed limits on a display. True speed is calculated using GPS and information about the speed limit is retrieved using a digital map system together with the GPS. The pocket PC provides audiovisual feedback to the driver. If the driver exceeds the speed limit, an auditory warning signal is activated together with a visual warning signal on the display of the pocket PC.

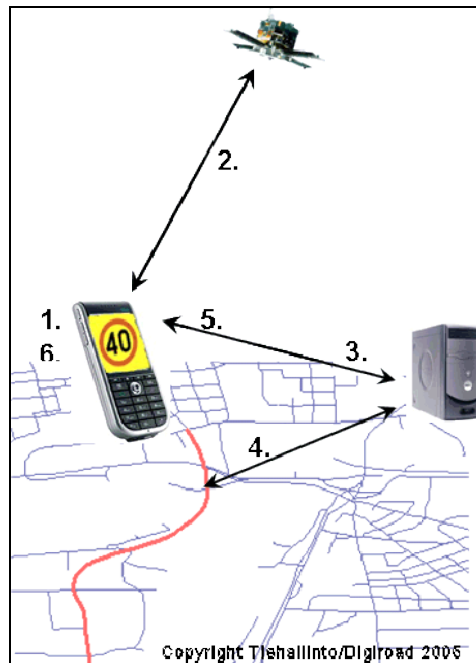


Figure 16. Speed information system architecture using a Pocket PC.

6.4.3 Parking Area Control system

In a Parking Area Control system the parking permission of a vehicle on a certain restricted area, where parking is allowed only to a number of registered vehicles, is checked. The system can identify the valid and invalid vehicles in this parking area and issue a fine to those who do not have permission to park there. If the GPS coordinates belong to a Bounding Box of “No Parking Areas” AND the vehicle’s speed is zero then it has parked in a forbidden area. The system should be able to identify if the driver is making a short stop. The Parking Area Control system consists of two parts: the client part, which is attached to the vehicle and the server part, which is attached to the control centre. The client part transmits the coordinates (longitude and latitude) of the vehicle and also its ID; the server part processes these values in order to identify whether or not a violation occurred. The Global Positioning System (GPS) provides the latitude and the longitude of the vehicle together with the vehicle’s direction (if necessary). General Packet Radio Service (GPRS) or Universal Mobile Telephone System (UMTS) can be used for data transmission to the control centre. When the vehicle transmits data to the control centre, the system generates output, describing the violation status of the vehicle. Finally, when a violation has occurred, the Control Centre should be able to communicate with the responsible enforcement agency for the automatically issuing of a fine.

6.4.4 One-way Road Violation system

In the One-way Road Violation system the position and the direction of movement of a vehicle are identified and checked whether the vehicle is driving in a forbidden direction. The system should also be able to issue a fine when it identifies a violation. If the GPS coordinates belong to a Bounding Box of "One way street" AND GPS Direction is opposite from the allowed one, a violation has occurred. The technical requirements are virtually the same as described in section 6.4.3 above but the vehicle needs to transmit its heading as well.

6.4.5 Future use of positioning technologies for Traffic Law Enforcement

Overall, the positioning and location technologies offer great potential for future application in the field of Traffic Law Enforcement. The upcoming introduction of the Galileo promises to provide a greater range of possibilities for these applications, as the accuracy level of positioning is going to be enhanced. Moreover, the continuously growing introduction of positioning technologies in the everyday life of road users, such as in-vehicle and pedestrian navigation systems, is making the public more accustomed to such applications and thus, the acceptance of the described applications would become greater with time.

6.5 *Implications of new technologies for European cross-border Traffic Law Enforcement*

Effective and efficient cross-border enforcement, aiming at a fair treatment and a proper enforcement of foreigner violators, requires communication of data across borders. Currently, each Member State has its own proprietary IT solution to record, process and send TLE data between police, public prosecutor and courts. The technology challenge is to develop and implement a common denominator that can capture all these in-house data and can communicate these to the appropriate authorities in an efficient and language independent manner across the borders of the EU Member States. Receiving parties/Member States have to be absolutely confident that the received data is reliable, secure, and safe and can be used without any further burden of proof.

Therefore, a standardised IT concept has to be put on top of the national TLE systems, to be organised, managed, and operated in a common EU concept, accepted by all Member States. This can only be achieved if there will be a European legislative instrument that will institutionalise cross-border enforcement.

6.5.1 IT solution and architecture

To guarantee interoperability between systems, acquired data, and functional fulfilment of reliability, security, quality and privacy across the border of the EU Member States, a common IT architecture has to be defined. This architecture should also enable language independent exchange of enforcement information, including all steps in the enforcement process. As described in the introduction of this section, a cross-border technology concept should not be a substitute for existing systems, but should be put/interfaced on top of existing IT architectures concerning enforcement information, information exchange and data. At the moment, no IT connections/interfaces between national enforcement IT architectures across the borders exist.

As a consequence, no automated intelligent exchange of enforcement information is possible. This needs to be addressed but before that step, the national systems do need to be updated for the automated handling of foreign violators.

The updates need to include the retrieval of foreign vehicle data and registered owner/keeper data and the notification in the language of the foreign violator. The VERA2 project (VERA2, 2004) captured those functions in a cross-border flow diagram (Figure 17).

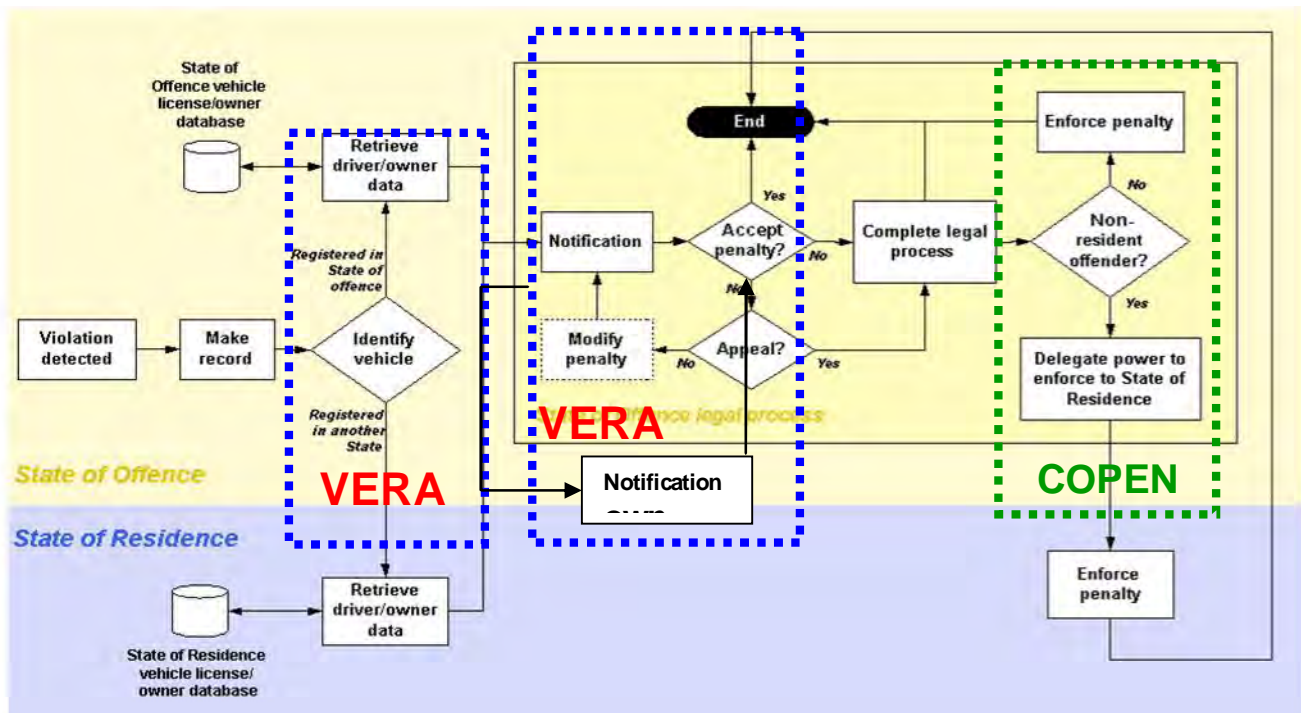


Figure 17. Cross-border enforcement flow diagram (see PEPPER D3 or details).

The third step in the entire enforcement chain, the execution of a financial penalty according to a legal court sentence that does not allow any more for further appeal, is captured in the so called “Framework Decision on the mutual recognition of financial penalties”, published in February 2005.

In short, this Framework Decision (also known as COPEN) obliges the EU Member States to execute a financial penalty imposed on one of their residents, for which the person in question has been sentenced by the legal system of the state where the violation was committed. However, despite the fact that decisions by the 3rd pillar (Community) of the EU policy require unanimous decisions, Member States are not obliged to transpose this Framework decision into national law, whereas decisions taken by the 1st pillar (Transport) have to be transposed into national law. This strange phenomenon is one of the major barriers for the institution of EU cross-border enforcement; it is an institutional/legal issue strongly related to the so called subsidiarity principle (a State’s autonomy is untouchable), not a technology one. At this moment, 7 EU Member States have ratified this FD and have transposed it into national law.

A working IT solution is described in Figure 18 below.

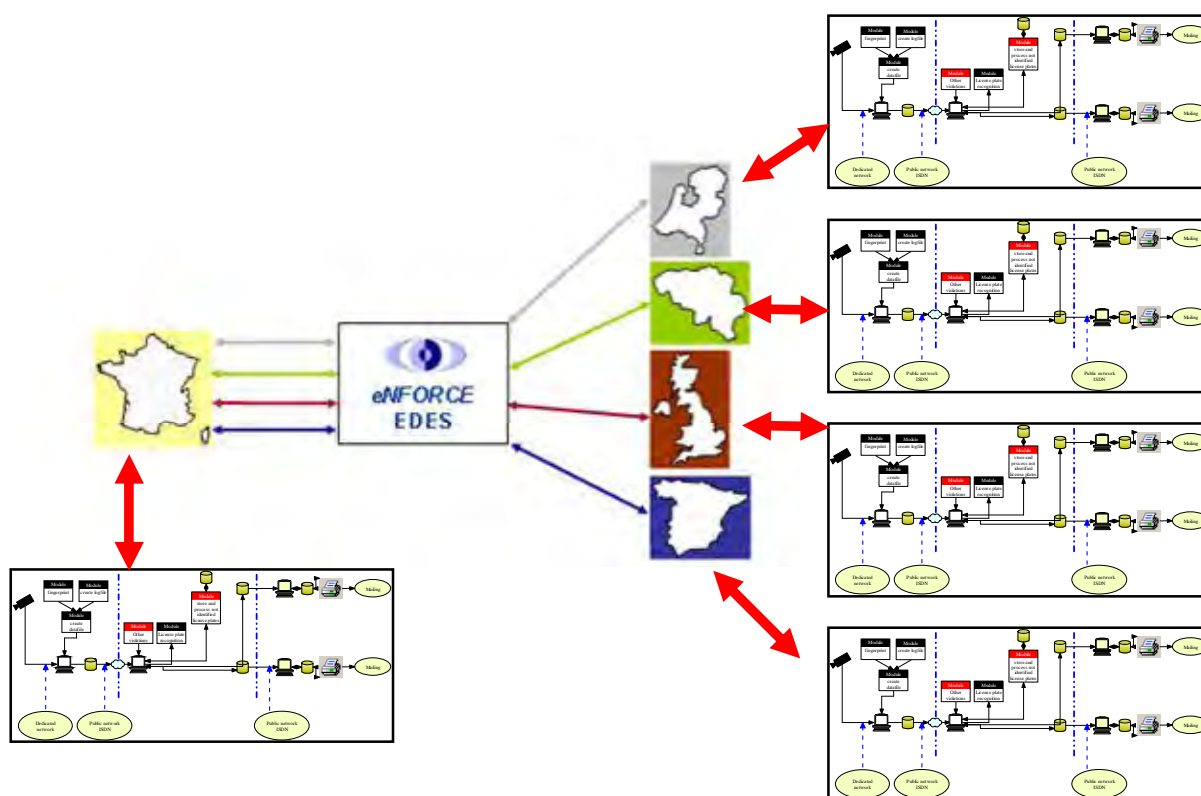


Figure 18. EDES solution (see PEPPER D3 or details).

In this architecture, the national IT systems for Traffic Law Enforcement are linked to an EU standard IT concept, enabling for the language independent exchange of information. This “Enforcement Data Exchange Service (EDES) requires a number of provisions; one of them being a standardised data model and a data dictionary, in which all the enforcement data are captured. This has been captured in the so called *eNFORCE* concept, developed by VERA2 (VERA2, 2004). The *eNFORCE* concept comprises two key elements:

- A ‘network’ of authorities and organisations (known as *eNFORCE* Authorities) in participating Member States, who are certified as being competent to delegate the power to enforce a penalty (in the case of an Issuing State) and to enforce a delegated penalty (in the case of an Executing State). *eNFORCE* is designed to be used by both public and private sector organisations.
- A data exchange service which *eNFORCE* Authorities use to exchange all data necessary to delegate the power to enforce a penalty and to enforce a delegated penalty.

An *Enforce/EDES* architecture (VERA3, 2008) is illustrated in Figure 19 below.

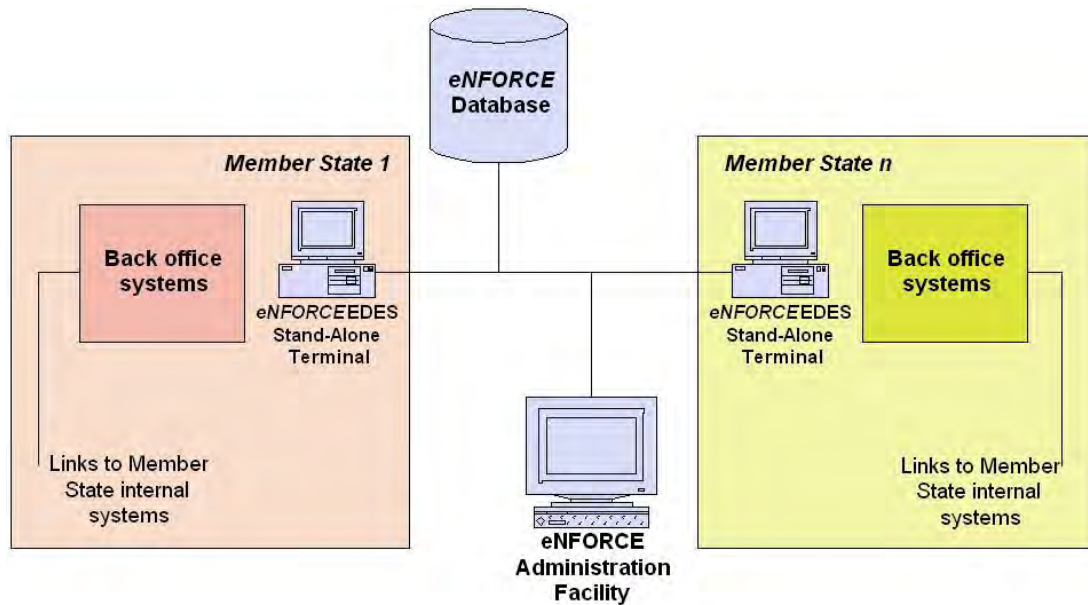


Figure 19. EDES cross-border exchange architecture.

This architecture will be tested in the VERA3 project in the 2nd half of 2008 between 3 agencies of Ministries of Justice in the Netherlands, France, and Spain.

6.6 Conclusions

1. It has been estimated that enhanced enforcement could reduce road accidents fatalities by approximately one third (ETSC 2006). This potential can be realized with the help of innovative active and passive enforcement systems and technology.
2. Legal and administrative barriers for efficient and effective implementation of innovative enforcement systems should be removed. These barriers include technical (lack of an EU type approval mechanism), institutional (who will be the agencies responsible for implementation, operation, updating and maintenance) and legal barriers (caused by privacy issues insufficiently covered in national law or restricted by national law, e.g. driver vs. owner/keeper responsibility). Such barriers should be addressed and removed, starting at and being pushed from the EU policy level and lawgiving chain, down to all Member States. Member States should address this as well, the initiative has to spark at both levels, and cooperation on this should be pursued with the European Commission, making it a really joint effort.
3. Section speed control, where speeding vehicles on a stretch of road are automatically detected, can be regarded as one of the most effective enforcement systems, as it can reduce the proportion of speeding vehicles to less than 1%. If implemented generically in all Member States, the number of traffic accidents that are due to speeding could be significantly reduced. Section speed control not only reduces accidents but it has positive effects on traffic flow, congestion, and on air quality and noise.
4. Alcolock in a car prevents persons whose blood-alcohol concentration (BAC) is above the legal limit, from driving. Alcolocks prevent recidivism on drink-driving and reduce

frequency of violations and alcohol-related accidents. Possible detrimental effects are fraud (e.g. driver makes someone else blow into the alcolock) and costs. High costs can prevent people from installing the alcolock. In some countries legal obstacles can prevent the implementation of alcolocks.

5. Implementation of automated seat belt detection system, based on digital camera images, could raise the intensity of seat belt enforcement to a new level, and increase wearing rates. Consequently, fatalities and serious injuries resulting from road accidents would be reduced. According to the pilot study it seems that the detection success of an automatic system can be very close to the situation of visual detection. Privacy issues might be an obstacle for effective use, as in the case of automatic speed enforcement.
6. Regarding passive enforcement, intelligent speed adaptation (ISA) also has huge potential in reducing speeding and accidents. It is acceptable to a majority of drivers who had experience with it. There are some obstacles, however, that have to be solved before the system can be implemented on a large scale: costs of in-car and infrastructure equipment, accurate speed limit databases are not widespread, and pilot studies have demonstrated confusion because speed limits varies as a consequence of road maintenance and temporal work zones.
7. Positioning technologies can be widely applied in active and passive enforcement, e.g. speed enforcement, parking area control and congestion charging. In such surveillance and enforcement systems vehicles are identified on the basis of their licence plates or specific electronic identification tags, and information concerning vehicles and their location (depending on the application also its travelling direction and speed) are transmitted to the control centre, e.g. by employing GPRS or UMTS technology. Ticket or fees are issued automatically.
8. Regarding cross-border enforcement, a common language-independent system for exchange of information regarding vehicles, owners, drivers and infringements need to be established, as suggested and tested in the VERA2 and VERA3 projects. Furthermore, the laws regarding the execution of financial penalties for traffic violations committed in another Member State need to be synchronised with the Framework Decision on the mutual recognition of financial penalties (Commission of the European Communities, 2004).

7. GOOD PRACTICES IN TRAFFIC LAW ENFORCEMENT

The results presented in this chapter are based on PEPPER deliverables 4a, 4b, 5, 9, 12, 13, 14 and 15.

7.1 *Good practices in strategic planning and tactical deployment*

7.1.1 Introduction

The aim of the work described below was to identify and describe good practices in Traffic Law Enforcement regarding strategic planning and tactical deployment. The results are described in detail in PEPPER D5.

Strategic planning of TLE covers all medium- to long-term plans based on the overall goals and objectives of police enforcement policy. The strategic plans aim at producing fundamental decisions and actions that shape and guide

- what is done to achieve the goals and objectives developed,
- who is designated to do it within the organisation and
- what resources are provided for this.

Hence, strategic planning deals with the “big picture“ of TLE, a sort of breakdown of goals into a doable concept of police enforcement.

Tactical deployment of TLE covers the short- to medium-term (usually less than a year) operative design of police enforcement. It comprises the planning of concrete, detailed actions performed by police resources in the field that are necessary to support and accomplish the overall strategic plan and goals set. Tactical deployment determines

- where (location),
- when (time) and
- how TLE is carried out by policemen.

Hence, tactical deployment is based on the strategic elements developed and is conducted at a lower level than strategic planning.

7.1.2 Identification of good practices

Potential good practices in Traffic Law Enforcement regarding strategic planning and tactical deployment were identified by means of a questionnaire survey and literature study. Questionnaires were sent to contact persons in the EU Member States plus Norway and Switzerland. Responses were received from 11 countries. Potential good practices were then analysed and assessed e.g. regarding performance and possible barriers of implementation as well as possible potentials for improvement. The process is described in Figure 20.

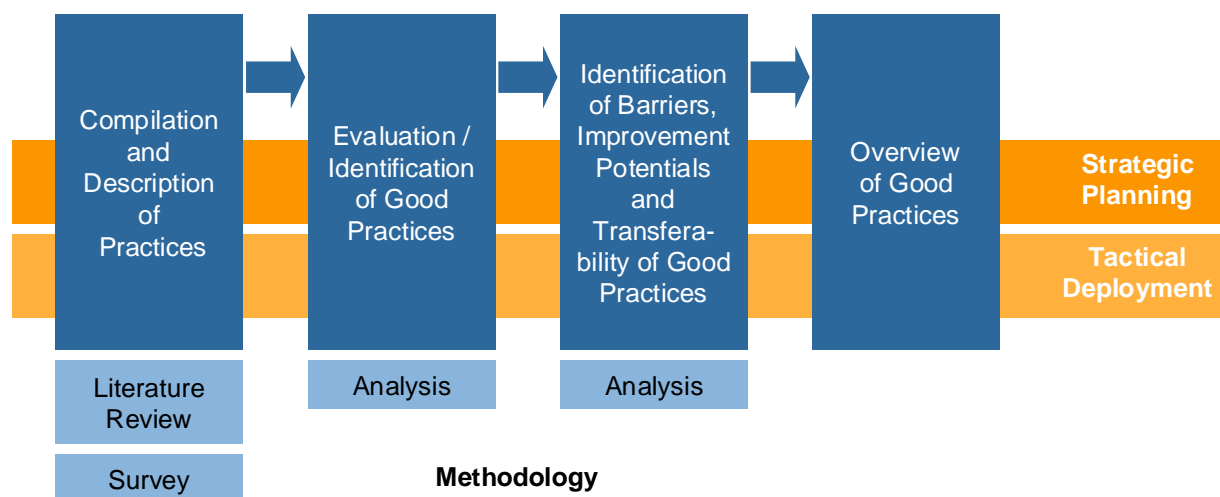


Figure 20. Identification of good practices in strategic planning and tactical deployment of TLE.

7.1.3 Good enforcement practices

The identified good enforcement practices are summarised in Table 2.

Distinction between *strategic* and *tactical* is not always clear. Moreover, the displayed distribution should not be seen as fixed but depending on situation. For example, the implementation of breathalyzers can be considered a strategic issue, but after implementation their use becomes a tactical issue.

It was not considered meaningful to even try ranking the practices according to how good or effective they are, because the efficiency depends not only on the practice itself, but also on the application environment. For example, the efficiency of a certain enforcement practice may depend on legislation, road infrastructure and enforcement organisation and resources.

Furthermore, drawing a line between good and not-so-good practices was not easy either, because there was not always sufficient evidence of the effectiveness or efficiency of suggested practices. Consequently, the enforcement practices presented in Table 20 can be considered more as practices that practitioners in different countries have considered good rather than a result of a strictly scientific evaluation. In a way, Table 20 can also be considered as a checklist for improving enforcement.

Table 2. Good practices in strategic planning and tactical deployment of TLE.

Identified Good Practices	
General	
<ul style="list-style-type: none"> • Enforcement planning systems and methods • Special Traffic Police • National system for monitoring traffic behaviour • Income related fines • Demerit point system 	
Drink-driving enforcement	
Strategic Planning <ul style="list-style-type: none"> • Enforcement plan with monitoring and controlling system • Integrated concept of enforcement, education and public campaigns • Delegation of responsibility on local police authorities • Presentation of “shocking videos” • 0.0 mg/l BAC for young drivers and beginners • Relative BAC-limit in accordance with signs of unsteadiness or unsuitability for driving or causing an accident 	Tactical Deployment <ul style="list-style-type: none"> • Black spot surveillance • Target group surveillance • Alcohol checks for drivers on every road accident • Alcohol checks for drivers which are stopped for a traffic offence • Obligatory breath testing at any stopping of car • Random breath testing • Evidential breath analysing • Comprehensive approach with mass screening checks • Screening instruments in every police car • Special team for planned random breath testing actions • Media involvement / public campaigns
Speed Enforcement	
Strategic Planning <ul style="list-style-type: none"> • Speed enforcement as a comprehensive approach • Delegation of responsibility on local police authorities • Evaluation of speed enforcement actions • Feedback system with the intention to adjust enforcement activities • Low tolerance threshold • Implementation of section control systems • Automatic traffic surveillance used on black spots • Extensive use of speed cameras • Highly visible speed enforcement • Enforcement Mix • Additional speed enforcement by local authorities • Use of PROVIDA-Vehicles (Proof Video Data Systems) • Media involvement 	Tactical Deployment <ul style="list-style-type: none"> • Intelligent selection of road stretches for speed enforcement activities • Black spot surveillance (school areas, high risk stretches) • Target group surveillance • Showing presence at unexpected locations and times / visible police controls • Concept of “rotating intensified traffic surveillance” • Repetition of speed enforcement regarding place and/or time • Stopping of offenders by police • Stopping a car based on speed rating by police officer • Media involvement at local enforcement efforts • Media involvement at nationwide campaigns
Enforcement of seat belt use	
Strategic Planning <ul style="list-style-type: none"> • Education and mass media campaigns • Seat belt (and child restrain system) checks at every road side check by police • Monitoring of seat belt use to have feedback on enforcement activities • Intense periodic seat belt enforcement action • Targeted seat belt use controls 	Tactical Deployment <ul style="list-style-type: none"> • Black spot surveillance in combination e.g. with child restrain enforcement - school areas, entertainment areas • Target group surveillance • Stopping of offenders by police • Detection of non-use within speed enforcement • Media involvement at nationwide or regional campaigns

7.2 Good practice in the selected key areas: Speeding, drink-driving and seat belt wearing

7.2.1 Introduction

The objective was to give a systematic review of evaluation studies on speeding, drink-driving and seat belt wearing by applying meta-analyses to previous studies on the subject. Meta-analysis enables the calculation of an estimate of the effect of any given enforcement measure by a weighted average across a large number of studies. The results are described in detail in PEPPER D9.

7.2.2 Speed enforcement

Categories of speed enforcement measures

The preparation for meta-analysis of speed enforcement measures draws upon the distinction between measures adopted in the review of literature in Elvik and Vaa (2004). At that time the following subgroups of speed enforcement measures were separated:

- Stationary speed enforcement
- Patrolling
- Automatic speed enforcement (speed cameras’)

A distinction between stationary and mobile (patrolling) speed enforcement is needed because halo effects have been found to be at work both in time and space for stationary enforcement, but not for mobile patrols (Shinar and McKnight 1985; Vaa 1993). *Time halo effects* means that an effect can be found in a given period of time after enforcement have ended, while *distance halo effects* means that effects on speed have been found at a certain distance from the spot where the speed enforcement is carried out.

The following techniques of stationary speed enforcement are used:

- **Stationary speed enforcement using laser or radar** that measures speed from one, usually unobtrusive or hidden observation site, or instruments that measure mean speed between two fixed observation sites and clearly visible apprehension sites staffed by uniformed police officers and marked cars.
- **Stationary radar/laser enforcement “American type”**. The police observer (sometimes one officer alone in a car) measures speed by a radar or a laser pistol and then pursues offending vehicles straightaway in order to apprehend and sanction the speeding driver.
- **Patrolling**: Mobile police patrols with marked cars or motorcycles.
- **Composite police controls with stationary and visible elements**: This term is used to illustrate that speed enforcement may utilize a whole range of different techniques and methods, but also that it comprises some element that is stationary and that some of the activity is clearly visible to the drivers passing by.
- **Speed cameras**: Several deployment patterns can be distinguished: 1) Fixed speed cameras, most often visible, on fixed locations (poles or portals) with a mobile camera

moving around, or 2) Mobile cameras, less obtrusive or even hidden cameras used on different locations, and 3) section control of speed (where the average speed between two fixed sites is calculated and enforced if the speed limit is violated).

A total of 45 evaluation studies on speed enforcement were identified and found to be of an acceptable quality. The 45 studies have been published in 14 countries and comprise a total of 129 results, mostly from USA, Australia, UK and Sweden. Two thirds of the studies have been published in the 1990s or after 2000.

Effects of speed enforcement measures

Results from tests of heterogeneity and summary effects of the estimated effects of speed enforcement on accidents are shown in Table 2. The overall result is a significant reduction of 18% in the number of accidents. There are large differences between the estimated effects of different types of speed enforcement. The trim-and-fill analyses indicate that the results for mobile speed cameras are affected by publication bias, but this is the only subgroup affected.

Table 3. Summary effects of speed enforcement measures. All accident severities

	Test of heterogeneity			Change of number of accidents (%)	
	Cochran's Q	df	p	Summary effect	95% confidence interval
All measures	5307.82	128	0.000	-18	(-23; -13)
Stationary manual	1854.17	22	0.000	-11	(-22; +1)
Patrolling	62.7573	10	0.000	-6	(-16; +4)
Radar laser US/AUS	22.3372	30	0.841	-0	(-3; 4)
Speed cameras (all types)	1693.9	42	0.000	-30	(-38; -23)
- Subgroup: Mobile speed cameras	168.476	12	0.000	-17	(-34; 4)
- Subgroup: Fixed speed cameras	1513.02	27	0.000	-34	(-42; -25)
Composite Other	454.306	20	0.000	-18	(-33; +1)

There are significant amounts of heterogeneity in all results, except for radar / laser of the type used in USA and Australia. Comparing the summary effects between the subgroups shows that larger accident reductions have been found when:

- the enforcement site was signposted;
- there is no randomization in the study design (all results with randomization refer to Radar / laser US / AUS);
- when there is local publicity, compared to a publicity campaign or no publicity;
- when a new form of enforcement is introduced and when the intensity is increased by a large amount;
- in the UK compared to other countries;

- accidents are severe;
- in studies with a weak study design.

The effects were not different depending on whether or not enforcement is visible.

7.2.3 Drink-driving enforcement

Categories of drink-driving enforcement measures

Most studies of the effects of DUI (driving under the influence of alcohol) enforcement on accidents have investigated the effects of *DUI checkpoints*, and some studies have investigated the effects of *patrolling*.

DUI-checkpoints refers to all police operations where one or more police cars are standing at the roadside (not driving) and where police officers pull out drivers in order to check whether or not a driver has an illegal BAC level. Such checkpoints may vary with respect to how large and how visible they are, to what degree DUI-checks are conducted at random times or places or only on roads and at times with high frequencies of DUI accidents, if all drivers are stopped at the DUI-checkpoint as far as the capacity of the checkpoints allows, or if only some drivers are stopped. When all drivers are not stopped, drivers may be stopped randomly or on suspicion only. In many countries, there are DUI-checkpoint programmes where the checkpoints are combined with media campaigns.

Patrolling: The types of measures investigated range from a mere increase of the amount of patrolling to larger programmes where officers are trained in DUI apprehension and where other anti-DUI measures are implemented at the same time. Most of the larger programmes have been accompanied by publicity.

Effects of drink-driving enforcement measures

Many studies have aimed at investigating effects on accidents involving alcohol. Since precise information on the BAC of drivers involved in accidents is not always available, many studies have used some substitute measure for alcohol accidents. Mostly, weekend night accidents have been used as a substitute measure for accidents involving alcohol. In short, the studies are grouped as follows: a) Accidents involving alcohol, b) All accidents, c) Daytime accidents.

Regarding patrolling, the results indicate that show that the overall effect is a reduction in the number of accidents by 8% (-12; -3). A significant accident reduction was found only in studies with a weak design, not in studies with a good design (table 3). For injury accidents with unspecified severity, the effect is a reduction of 7% (-14; -1). For night-time accidents the reduction is 9% (-17;0). For fatal accidents, no significant effect on accidents was found.

Table 4. Summary effects of alcohol enforcement by patrolling on accidents.

Type of accidents affected	Test of heterogeneity			Change of number of accidents (%)	
	Cochran's Q	df	p	Summary effect	95% confidence interval
All results					
All accidents	156.41	26	0.000	-8	(-12; -3)
Good vs. weak study design					
All accidents, good study design	54.38	20	0.000	-4	(-8; +0)
All accidents, weak study design	2.680	5	0.749	-24	(-28; -20)
Injury, fatal and night time accidents (good study designs only)					
Injury accidents / unspecified severity; all types of accidents	39.62	6	.000	-6	(-11; 0)
Injury accidents / unspecified severity; all types of accidents – outlier omitted	25.98	5	.000	-7	(-14; -1)
Injury accidents / unspecified severity; night time accidents	22.97	4	.000	-9	(-17; 0)
Fatal accidents; all types of accidents	14.71	13	.325	-1	(-7; +5)

DUI checkpoint enforcement seemed to reduce accidents by 15% on the average. The results are affected by publication bias, which was corrected for by the trim-and-fill analysis (Table 4).

Table 5. Summary effects of DUI checkpoints on accidents.

	Test of heterogeneity			Change of number of accidents (%)		Trim-and-fill analysis: Change of number of accidents (%)		
	Cochran's Q	df	p	Summary effect	95% confidence interval	Summary effect	95% confidence interval	Number of new effect estimates
All results	1007.221	96	0.000	-17	(-20; -14)	-15	(-18; -11)	7

There are significant amounts of heterogeneity in all results, which indicates that the results of individual studies were affected by moderator variables. The effects of moderator variables were investigated by meta-regression analysis, which show how the potential moderator variables affect the effectiveness of DUI checkpoints when controlling for all other potential moderator variables (time period, country, study design, accident type, testing of drivers, accident severity and publicity) at the same time. The results of meta-regression show that *larger accident reductions* have been found when:

- shorter time periods are studied, i.e. the largest accident reductions are found during the first half year;

- in Australia compared to New Zealand and USA, and New Zealand and USA compared to other countries;
- in studies with a weak study design;
- accidents involving alcohol; this effect becomes even stronger when the results are controlled for publication bias;
- when not all drivers are tested at the checkpoints, compared to checkpoints where all drivers are tested, the difference is however not large;
- for injury accidents compared to fatal accidents, the difference becomes larger when the results are controlled for publication bias;
- publicity involves paid media, compared to publicity with unpaid media only.

All results are significant, with the exception of the results for checkpoints in countries other than Australia, New Zealand and USA.

7.2.4 Seat belt enforcement measures

Categories of seat belt enforcement measures

The following types of seat belt enforcement measures have been investigated:

- Stationary control at the roadside, checkpoints, mostly combined with speed or DUI enforcement
- Canadian and USA STEP programs (STEP: Selective Traffic Enforcement Program)
- Combinations of checkpoints and mobile controls
- Secondary seat belt law enforcement with stopping of car drivers for other offences and issuing seat belt citation as second offence citation (this type of enforcement is excluded from meta-analysis as secondary enforcement is an American practice, not European)
- Educational enforcement of use of child restraints with leaflets and warnings instead of tickets

Most studies have investigated the effects of primary seat belt law enforcement on seat belt wearing. Although seat belt enforcement measures differ in several ways, there are no clearly distinguishable groups of different types of enforcement measures. For example, seat belt control at checkpoints may or may not be primary seat belt enforcement. The Canadian and USA STEP programs have been investigated in only one study each. Meta-analysis is conducted based on the studies of the effects of seat belt enforcement on seat belt wearing.

Effects of seat belt enforcement measures

Enforcement increases significantly the seat belt usage rates. Compared to the before enforcement period, increases were larger during the enforcement period than after the enforcement period (Table 5).

Table 6. Summary effects of all seat belt enforcement studies on seat belt wearing rate.

Before – During					Before - After				
Test of heterogeneity			Change of seat belt usage(%)		Test of heterogeneity			Change of seat belt usage(%)	
Cochran's Q	df	P	Summary effect	95% confidence interval	Cochran's Q	df	p	Summary effect	95% confidence interval
924.28	29	0.000	+21	(+16; +27)	391.37	29	0.000	+15	(+10; +20)

Further analysis of mediator variables revealed that

- seat belt enforcement is more effective in the USA than in other countries when regarding before-during comparisons, and least effective in Belgium;
- in before-during comparisons larger increase of seat belt use have been found in studies which have not applied a control group; however, in before-after comparisons the difference between studies with and without control group is only minor;
- there are no systematic differences in the effects on drivers and front seat passengers;
- seat belt enforcement is more effective in increasing seat belt use at night; this result refers only to before-during comparisons and is based on only one study,
- seat belt enforcement that is conducted without signposting is more effective than signposted enforcement;
- local publicity and a publicity campaign increase the effectiveness of seat belt enforcement compared to no publicity or enforcement programmes (it is likely that enforcement programmes include at least some components of a publicity campaign).

The amount of heterogeneity remains significant in almost all subgroups. This indicates that the results within each of the subgroups are affected by further moderator variables.

Enforcement of the use of child restraints

Only one study has been found that has investigated the effect of enforcement on the use of child restraints. In this study a non-significant increase of the use of child restraints by 15% has been found (95% confidence interval [-13%; +25%]). Strictly speaking, this study does not concern enforcement, since no tickets were issued. Only information was provided and drivers not properly using child restraints got warnings but no fines.

7.3 Evaluation of the 0.0 BAC limit for drivers of road vehicles in Czech Republic, Slovakia, Hungary and Croatia

Driving while intoxicated is one of the key risk factors and the second most common cause of fatal accidents after speeding. National governments therefore set and enforce a legal limit, which level varies considerably among countries. There are four countries in Europe which apply a general zero BAC (Blood-alcohol Concentration) limit for all drivers of motorized vehicles: Hungary, the Czech Republic, Slovakia and Croatia. The aim of the study was to find

out if the countries with zero limit reach better performance in terms of alcohol-related road injuries compared to those countries which apply a non-zero BAC limit.

Accident data from several EU countries with different BAC limits were used to assess the effectiveness of BAC policies in the four zero limit countries. The results pointed on the one hand to fairly good performance of zero BAC limit countries (Figure 20, data from Croatia is missing), but on the other hand unveiled shortcomings in accident statistics, more specifically certain level of underreporting and a lack of common definition and harmonized reporting practices.

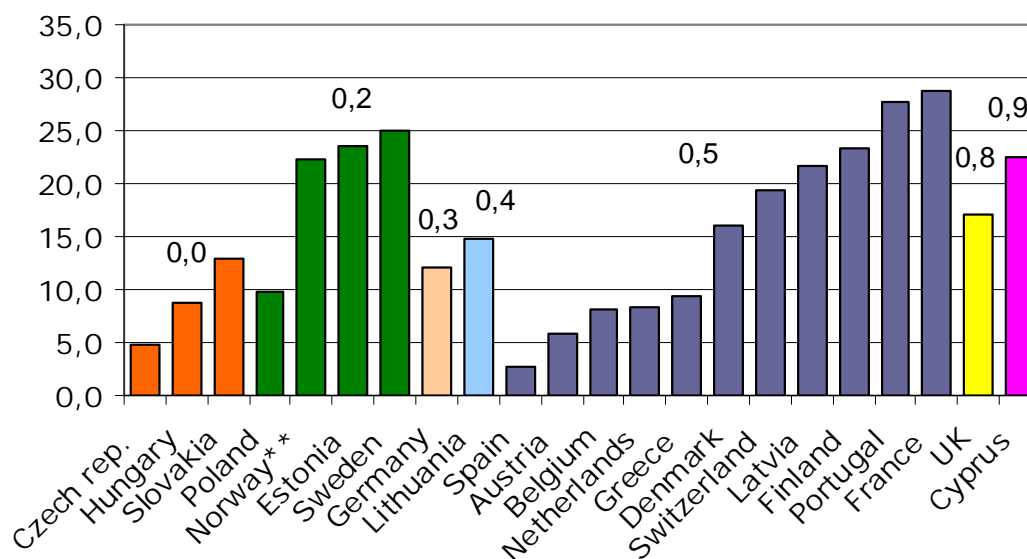


Figure 21. The percentage of fatalities resulting from accidents involving at least one driver impaired by alcohol in countries with different legal BAC limit.

In order to investigate all relevant background aspects, a questionnaire was distributed to relevant organizations and institutes involved in the Traffic Law Enforcement chain in the four countries. Information gathered included historical and social context, legislation, enforcement practices and crash data.

The countries with zero limit and those with no-zero BAC limit can be found side-by-side in Europe in terms of their road safety performance. Among the four countries compared, Croatia performs worst with over 2.5 alcohol related accidents per 100,000 inhabitants, while the respective figure in Hungary, the Czech Republic and Slovakia is closer to 1–1.5. This could be partly attributed to a late introduction of the zero limit in Croatia, insufficient enforcement and higher number of risky drivers, especially novice ones.

Analysis of the background factors suggested that historical and social context together with enforcement level are the strongest factors in determining differences in the prevalence of alcohol in injury crashes in various countries. It was concluded that the BAC limit itself plays only a minor role in preventing drink-driving and alcohol related crashes.

Successful implementation of zero BAC policies in the four EU countries is the results of favourable historical development, wide acceptance by the public and a general climate

condemning drink-driving. These results are likely not transferable from country to country as each one has different predisposition for the choice of drink-driving policies.

7.4 Good practice in data, data collection and data use for monitoring and evaluating Traffic Law Enforcement

7.4.1 Introduction

The study focused on the last part of the enforcement chain: the effect on road user behaviour and on road safety. The objective was to define good practice in monitoring and evaluating the impact of TLE, in such a way that it can be applied (in due time) by police forces, decision makers and researchers. More specifically, it aimed

- to identify and define the data that ideally would need to be collected to allow for monitoring and evaluating the impact of TLE; and
- to specify the requirements for collecting and using such data in a reliable way.

The result of this task was aimed to be a detailed outline of the data needs and the data collection requirements for monitoring and evaluating the impacts of TLE. The focus was on TLE regarding drink-driving, speeding and seat belt wearing, covering both the intermediate impact (on road user behaviour) as well as the final impact (on road safety).

Since the aim was to identify good practice, i.e. the ideal situation, the work was theoretical in nature. It did not contain questionnaire or interview components to get information about current practice in the various Member States. Instead, the work was performed on the basis of expert knowledge and on published materials from former and current EU projects – notably GADGET, ESCAPE, SUNflower and SafetyNet – as well as on ongoing work both within the current project - notably in Work Package 2 "Model for an enforcement data collection system and associated pilots". It was not meant to be an in-depth theoretical analysis or justification. The focus was very practical in nature, in that the study aimed to make the future transition from the work in this task to an operational data collection and storage system as easy as possible.

The work carried out in this subtask is described in more detail in PEPPER D4a and PEPPER WP24.

7.4.2 The scope of the study

Eventually, the aim of road safety measures is to reduce the number and/or severity of road traffic accidents. It is important to monitor and evaluate the road safety activities to see whether this aim is realised and to see that effort and resources are spent successfully. This is also the case for Traffic Law Enforcement (TLE). The road safety pyramid, originally developed in New Zealand in 2000, and since then being developed and used widely in Europe as well, e.g. in the SafetyNet project and the SUNflower project. With some slight modifications, the pyramid was applied to the special case of TLE (Figure 21).

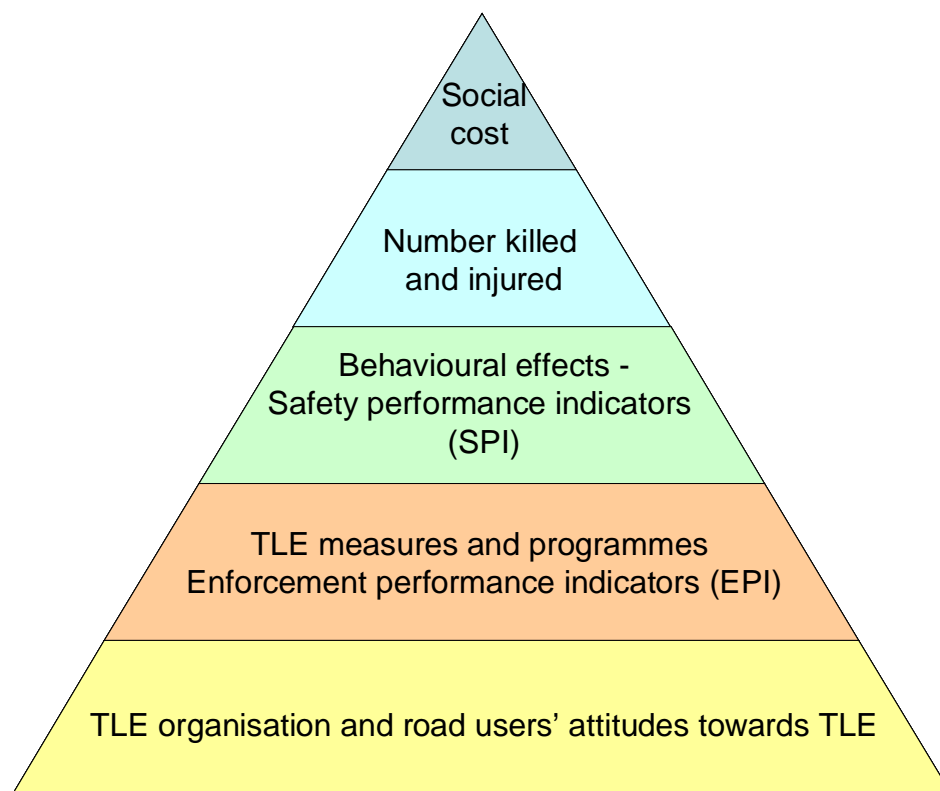


Figure 22. Traffic Law Enforcement pyramid.

The data that would be needed to monitor TLE activities and to evaluate their impact, the main objective of this task, are in the areas of Enforcement Performance Indicators (EPI), Safety Performance Indicators (SPI) and number of casualties in various injury severity classes. Therefore, the work focused on the three middle layers of this pyramid. For each of these data categories, the *ideal* set of variables was identified that would need to be collected to allow for the qualification 'Good Practice'.

7.4.3 Enforcement Performance Indicators (EPI)

By EPIs we mean the set of variables that describe the executed enforcement activities in a way that enables the monitoring of the general development in enforcement and the estimation of its effects on road user behaviour and accidents with reasonable accuracy. In addition, EPIs can be used in the planning of enforcement to facilitate the comparison of the original targets of the enforcement activities and the actual achievements. As such, EPIs may help to enhance the effectiveness and efficiency of enforcement.

A general requirement for EPIs is that they are reliable and valid. They must be country-independent, so that data from different countries can be compared. Furthermore, EPIs should be quantitative as far as possible even though qualitative variables, e.g. type of enforcement tool and road type, will be needed for categorisation. An ideal set of EPIs contains at least the following information:

1. Target behaviour;
2. Enforcement method and tools;

3. Quality indicator of the enforcement method and tool (e.g. the error of the speed measuring device was less than around 2 km/h).
4. Enforcement tolerance levels (e.g. only drivers exceeding speed limit by 11 km/h or more were regarded as violators, taking into account the possible error in the measuring device);
5. Location of enforcement (e.g. urban/rural, road type);
6. Duration of enforcement (starting and ending times);
7. The number of vehicles or road users checked;
8. Number of observed violations by severity category when appropriate (e.g. speeding categories 1-10 km/h, 11-20 km/h etc);
9. The number and type of sanctions issued (by severity category when appropriate);
10. Resource use (e.g. number of person hours, other resources in quantitative terms);
11. Use of supporting publicity campaigns and other information to the public to enhance the effects of enforcement.

Each of these was elaborated, resulting in tables showing the variables and their categories that would have to be collected for drink-driving enforcement, speed enforcement and enforcement of seat belt use, respectively. Table 6, for example, shows the kind of table we would need if we would want to describe the number of breath tests taken on different road types and on different times of day

Table 7. Example of tables describing alcohol enforcement.

		Time of day				
		00:00-08:00	08:00-16:00	16:00-24:00	Total	
random	urban area					
	rural area					
	motorway					
targeted	urban area					
	rural area					
	motorway					
Total						

A total of 23 EPI tables were developed for the three target behaviours. EPIs must always be derived from raw data describing the implemented enforcement measures. So, subsequently, we described the raw data that needed to be collected for the derivation of EPIs, resulting in a data collection form with, per enforcement activity, 40 variables that need to be completed for a particular enforcement session.

7.4.4 Safety Performance Indicators

A similar approach was applied for the Safety Performance Indicators (SPIs). In the context of the current study, SPIs can be considered as the intermediate, behavioural outcome of TLE measures (the EPIs), with number and severity of road accidents as the final outcome, as indicated in the TLE pyramid above. The advantage of using SPIs rather than accidents to assess the effectiveness of TLE is that the SPIs can be observed in much larger amounts than accidents, allowing for more reliable analyses. Clearly, SPIs cannot provide a direct measurement of the effect of different types of TLE. Other, simultaneous measures may affect SPIs as well. On the other hand, SPIs can provide a sufficiently fair indication of enforcement effectiveness, especially when applying time-series analyses. Furthermore, some SPIs describe the level of compliance with traffic law, which is related to the level of police enforcement. In this way, the effect of enforcement on road safety consequences can be indirectly estimated. For SPIs it is important that the data are collected independent of enforcement activities.

Many examples of relevant information concerning SPIs were identified in the areas of drink-driving, speed behaviour and seat belt usage. For each of these areas a data collection form specifies the data that need to be collected. For example, regarding speed behaviour in a particular country or region, the required information would be as presented in Table 7.

It is recognised that the derivation of the EPIs and SPIs requires considerable investments for data collection. However, the investments, which would concern mainly portable or in-vehicle computers and (wireless) data transfer tools, seem not unreasonable (within 5 to 10 years, for example) taking into account the ongoing development and declining cost of such tools. Furthermore, collecting and storing the data can be made easier by using intelligent computer programmes, for example featuring pull-down menus to select categories, which vary depending on the target behaviour. It was out of the scope of the current task to present in detail how this should be done in practice.

Table 8. Speed data collection form.

Required information									
1	2	3	4	5	6	7	8	9	10
Session information					Speed information				
Speed measurement session No.	Description of location	Code of police force in charge of location	Type of road	Speed limit in force	Vehicle No.	Type of vehicle	Date	Time	Measured speed
1					1				
					2				
					3				
					4				
					..				
					..				
					..				
					..				
					..				
2					1				
					2				
					3				
					4				
					..				
					..				
					..				
					..				
					..				
3									
4									
..									
..									

7.4.5 Number of casualties and severity of injury

The most direct measure of the road safety performance of a country or the effectiveness of a road safety measure is the number of casualties and the severity of the injuries. Ideally, also TLE efforts would result in a reduction of the number and severity of accident victims. Whereas, as already indicated, the number of accidents is often too small for reliable statistical analysis; in particular if the area or the time period under study is small, accidents need to be registered for monitoring purposes at larger scales or during longer periods of time.

Most countries already collect data on accidents, accident characteristics and casualties, such as location, date, time, age and gender. Most accident registrations also have some classification of injury severity, but this is generally based on the non-expert estimation of a policeman or based on a first quick scan by emergency staff. We see it as good practice to use the information from hospitals and first aid centres to provide more reliable and accurate information on injury severity. We suggest that this information is based on the Abbreviated Injury Scale (AIS) and the Maximum AIS score (MAIS). In the AIS each injury is classified by medical experts into six degrees of severity: 1 = Minor; 2 = Moderate; 3 = Serious; 4 = Severe; 5 = Critical; 6 = Unsurvivable. For the quantification of injury severity the maximum AIS

score (MAIS), i.e. the score of the most severe injury independent of the body region, is the most practical for the current aim. This approach would mean that the police register the number of persons involved in an accident who are not injured, the number of persons fatally injured at the spot, and the number of persons sent to hospital or first aid. For the latter group, the hospitals and first aid centres have to provide the medical indication of the injury severity, i.e. the AIS and the MAIS score. Clearly, this would need well organised co-ordination and co-operation between police and medical centres. However, it would lead to much more reliable and exact information about the injury severity of road accident victims and would allow better assessment of changes over time in accident severity.

7.4.6 Use of EPIs, SPIs and casualty information

We also elaborated on the principles of using this type of data for economic evaluations and effect evaluations of TLE efforts. Both activities are the area of specialists. The way we dealt with these issues was not meant to be a handbook for these specialists, but rather to set out the possibilities and pitfalls and to create understanding of the usefulness of reliable and valid data on EPIs, SPIs and casualties and the dangers of incomplete or biased data.

In the first place we discuss cost-benefit, cost-effect and cost-utility analyses as a tool for decision making. These analyses allow decision makers to decide on a rational basis whether it is worthwhile to carry out particular road safety measures, such as an enforcement operation. In all cases the costs of a road safety measure are compared to the benefits. The benefits of a measure can be expressed in monetary units based on the savings in the costs of road accident victims. This is a cost-benefit analysis. The benefit can also be expressed in terms of road accident victims prevented, or in the number disability adjusted life years (DALY) or quality adjusted life years (QALY). This is cost-effect or cost-utility analyses. The outcomes of these analyses allow the comparison of different measures based on their relative effects. It is also possible to weigh the outcome against a fixed criterion of what the minimum profit of a certain financial investment must be.

Secondly, whether or not for economic evaluations, it is important to know whether a TLE operation can be expected to have a positive effect and how it relates to the effects of another TLE operation. Good, reliable effect evaluations need to fulfil many criteria to be sure that, if effects are found, they can be attributed exclusively to the measure taken and that they are not the result of an artefact, such as regression-to-the-mean, accident migration, mobility changes or general developments over time. Lower quality studies that insufficiently take account of these confounding factors often report larger effects than higher quality studies, but these larger effects do not necessarily reflect the true effect.

7.4.7 Towards a good practice TLE database

The idea is that all data collected as described, would be stored in a European TLE database. The main use and users of such a database are threefold:

- National/regional police forces who can learn from other (inter)national forces what type of enforcement is performed and what the state-of-affairs is regarding related road user behaviour and road accidents.

- The European Commission who can get a good overview of the enforcement activities in the various Member States, as they aimed for with their Recommendation on Enforcement in the field of road safety.
- Road safety researchers who will get access to a huge database that allows for more thorough and larger-scale analyses of the impact of TLE on road user behaviour and accidents allowing for identification of critical elements of successful TLE as well as allowing for cost-benefit analyses.

To make this type of use possible, the quality and completeness of the collected data is of crucial importance. To ensure high quality and complete data sets, a substantial effort is required from those who collect and manage the raw data (the police, independent data collectors, medical centres) and those who manage the integrated database (preferably at the national level). This definitely costs more time and effort to realise than is currently spent in most countries. The question is to what extent the involved parties are willing to accept these extra efforts.

A first requirement to get a positive answer to that question is of course to make the extra administrative burden as small as possible. Therefore, it is important that the data can be stored easily in advanced, computerised data collection systems that are mutually and internationally compatible. Such data collection systems not only facilitate the work of the data collectors and database administrators, they also facilitate later analyses. There are many technical developments that will help to make the administrative burden much smaller than would be the case today. Training of data collectors and administrators will nevertheless be necessary in order to ensure an optimal and consistent use of the systems.

A second requirement is that the extra tasks are financially supported by the national or may be even by the European government. For this to happen, it is a prerequisite that the relevant decision makers are convinced of the usefulness of high quality and complete data sets and (inter)national comparisons. They need to be convinced that, eventually, these data will allow for better informed decision making and hence more cost-effective spending of limited road safety resources.

Within the context of the PEPPER-project we did not test the feasibility of our data requirements in practice nor did we elaborate on computerised data collection systems. As indicated, getting all required data from all EU countries in manageable formats cannot be realised over night. It will need a stepwise approach of at least several years. This need not be a problem, as long as intermediate databases, such as the one that was conceptually developed in Work Package 2, are sufficiently flexible to be compatible with the more advanced data requirements as described here.

7.5 Prediction of the effects on safety of traffic enforcement measures

7.5.1 Introduction

The objective was to develop a method for the prediction of the effects of traffic enforcement measures on road accidents and resulting casualties. The method should be easy to understand and use, even in cases where data for accurate prediction is not available. Consequently, the predictions made by the method are not very precise but usually they are probably accurate enough to enable rational assessment of planned measures before implementation and thus promote the implementation of effective and cost-efficient enforcement measures.

The work carried out in this subtask is described in more detail in PEPPER D4b and PEPPER WP 23.

7.5.2 Impact prediction

The basic idea is that enforcement affects road user behaviour by reducing traffic law violations, and because of the improved road user behaviour the number of accidents will decrease or resulting injuries will be less serious. Consequently, the success of the prediction depends on two aspects: a) how accurately we can predict the effect of enforcement on behaviour, and b) how well we know the association between behaviour and accidents. Both of these prediction stages involve data collection, utilisation of previous research results and, in the absence of other useful sources of information, also expert judgements. We need to know or estimate, for example, what proportion of car drivers does not use seat belts in the before-situation, how that proportion is likely to change because of increased enforcement, and how increased use of seat belts would affect fatal or severe injuries to car drivers. The main phases of the prediction process are illustrated in Figure 22.

It is acknowledged that the method typically enables only a rough prediction of the safety effect. One could say that the aim is to differentiate between measures that reduce the expected number of injury accidents by 0, 1, 10 or 50, for example. Furthermore, the comparability of alternative enforcement measures is improved if they are evaluated consistently by the same method. In that case the method also promotes a systematic approach to the evaluation of enforcement measures.

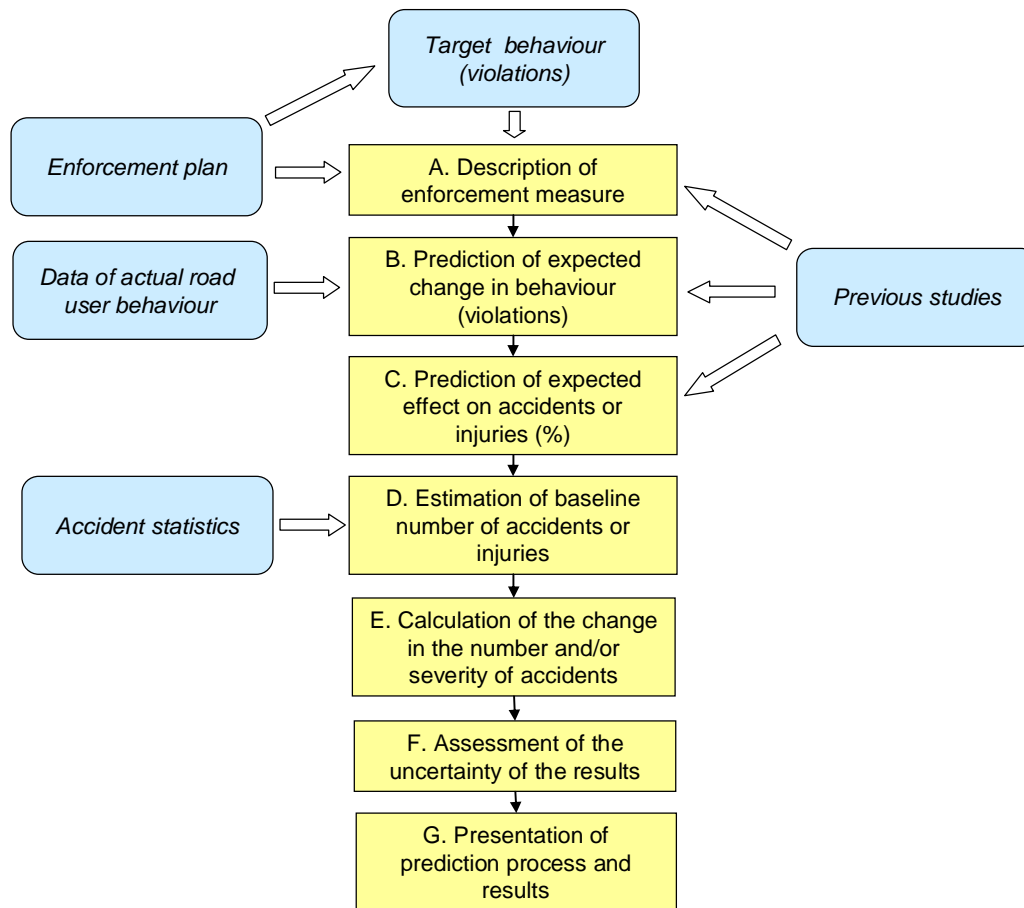


Figure 23. Outline of the process for the prediction of enforcement measures on road safety.

In addition to providing rough quantitative estimates of the expected outcomes, an essential feature of the method is that it is transparent in the sense that every step of the prediction process is explicitly described. The data used and the assumptions made during the process are visible. The transparency facilitates the assessment of the credibility of the prediction process and eases the detection of errors in data or judgement. It also makes it relatively easy to recalculate the impacts on safety if data or assumptions are updated.

Table 8 illustrates a practical application of the method. In Deliverable 4b two other examples are presented concerning the prediction of the effects of speed and alcohol enforcement.

Table 9. The predicted effect of increased enforcement of seat belt use in Norway

<p>Target behaviour: Wearing of seat belts among drivers and front seat passengers in cars in urban areas.</p>
<p>Enforcement measure: Increased visibility of seat belt control posts.</p>
<p>Target injuries: Injuries to drivers and front seat passengers of cars resulting from accidents in urban areas.</p>
<p>Predicted change in target behaviour: An increase of seat belt use in urban areas in 2008 by 4% from 88% to 92% (expert judgement supported by previously estimated effects of similar measures).</p>
<p>Predicted percentage change in target injuries: It is predicted that the number of fatalities in urban areas is reduced by 2.0%, that serious injuries are reduced by 1.8% and that slight injuries are reduced by 1.0% (based on previous studies which state that seat belts reduce fatal injuries by 50%, serious injuries by 45% and slight injuries by 25%).</p>
<p>Baseline number of injuries for drivers and front seat passengers: The baseline number of fatalities and injuries for 2008 are: 5.7 fatalities, 32.4 severely injured and 901.3 slightly injured (annual number of injured drivers and front seat passengers of cars in urban areas).</p>
<p>Change in the number of injuries: The expected change in the annual number of killed or injured drivers and front seat passengers of cars in urban areas are reductions of 0.1 killed (0.020×5.7), 0.6 seriously injured (0.018×32.4) and 9 slightly injured (0.010×901.3).</p>
<p>Credibility of the result: The effect on seat belt wearing is highly uncertain. The predicted increase in wearing rate may be too big, but it is not likely to be too low. The effect of increased wearing rate on injuries is based on studies and not a major source of error. Nor is the baseline number of injuries, which is fairly stable over years (regression-to-mean effect not likely). Positive side effects are more likely than negative side effects.</p>
<p>Conclusion: The predicted effects on injuries (in 10 years 1 fatal, 6 serious and 90 slight injuries would be prevented) are likely to be approximately correct. The effect on seat belt wearing rate (4% increase) may be too optimistic, but on the other hand the measure has positive side effects (reduction of other traffic violations).</p>

7.5.3 Conclusions

A practical method for the prediction of the safety effects of enforcement measures was developed and its use demonstrated by real-life examples. The output of the method is the number of accidents or injuries, which will be prevented if the measure is implemented. The calculations can be made by a simple pocket calculator or spreadsheet programme. All steps in the process are transparent and recalculation of the effect is easy if part of the input data or functions is updated.

Input data and functions should be based as far as possible on observations of road user behaviour, accident statistics and previous research of the effects of enforcement on road user

behaviour and the effects of changes in road user behaviour on accidents or injuries. However, the method can (and should) be used even in cases where part of required input consists of the expert judgement because of imperfect data or lack of applicable results of previous studies.

It is acknowledged that the predictions are usually only indicative of the size of the true effect because of uncertainties in the different stages of the prediction process. It is argued, however, that it is often useful to know if the expected savings in injury accidents are closer to 0.1, 1, 10 or 100 per year, for example. Resources for traffic enforcement are limited and even a rough idea of the expected effects of different measures can be valuable in the promotion of cost-effective enforcement. Furthermore, later comparison of the predictions to the observed effects can improve the accuracy of future predictions.

The method is probably most useful for the prediction of effects concerning extensive or combined measures, which cover a fairly large area and long time period, such as the annual enforcement of drink-driving in a country or region. Otherwise the predicted reductions in accidents or injuries may become so small (e.g. 0.06 injury accidents) that they have little practical use. In principle, however, the method can be applied to enforcement methods of any size and duration.

Even though the method is primarily based on the two steps (first concerning the effect of the measure on behaviour and the second concerning the effect of the change in behaviour on accidents), it is recommended that the results are compared to previous studies of the effects of enforcement on accidents (without consideration of the effects on behaviour) when such studies exist.

The credibility and accuracy of the predictions could be improved if there were more studies on the effects of different enforcement measures on road user behaviour and accidents. A major obstacle to such studies is the lack of reliable and reasonably accurate data of implemented enforcement measures. The development and adoption of more systematic enforcement data collection procedures across EU would not only stimulate new studies but enable learning from experiences in other countries and promote the creation and adoption of best practices in traffic enforcement.

7.6 Enforcement database Cleopatra

7.6.1 Introduction

The objective was to collect from selected countries (Finland, France, Germany, Netherlands, Sweden and United Kingdom) enforcement data describing practical experiences of Traffic Law Enforcement, and organise this data into an online database. This database should be accessible for police forces in EU Member States. The majority of these data should also be accessible for other institutes and organisations.

The database should consist of three different kinds of information and the information would be relevant for:

1. Police forces in Europe.

2. Police specialists in the areas of alcohol, speeding and seat belts.
3. Police and other specialists to compare national regulations and police power on specific traffic safety issues.

These three approaches are integrated in one CLEOPATRA database and placed at the TISPOL website (www.tispol.org) to ensure accessibility for any police officer in Europe and abroad. Furthermore, public access to the non-confidential parts of the CLEOPATRA database is provided.

The CLEOPATRA database is the first police-oriented database for Traffic Law Enforcement and contains information on police forces, police operations and police enforcement related research.

The ultimate objective of the CLEOPATRA database is to spread the knowledge of good practices across Member States and help their TLE practitioners adopt and adapt the practices into their unique systems.

The CLEOPATRA database was developed under the leadership of TISPOL and TISPOL representatives and PEPPER personnel in the involved countries provided the input data. European Transport Safety Council (ETSC) provided information from a Europe-wide perspective.

7.6.2 Data collection

The six EU Member States were selected based on the good experiences of these countries with road safety and the activities of the police in these Member States. The selection of Sweden, United Kingdom and the Netherlands was based on the SUN report. France was selected based on the experiences they had with road safety policy since the presidential recommendation in 2002. Finland was selected based on their road safety figures and the activities of the Finnish National Traffic Police. Germany was selected based on their “Program for more safety in road transport” in 2001 and the activities of the German police. To get an overview of the activities on a European level the task leader asked ETSC for help to develop a “Brussels”-view on road safety.

In the first stage, information concerning TLE was collected by a questionnaire sent to TISPOL council members in the selected Member States. The questionnaire contained approximately 130 questions and answering them all required considerable efforts. Apart from this questionnaire a document research has been performed for police related road safety issues. Therefore websites of research institutes, police forces and road safety organisations in Europe and abroad have been studied by the task leader. Information related to the road safety policy in general and the role of the police has been collected. But also information related to the spearheads of road safety has been collected and evaluated.

After receiving the answers the completed questionnaire from the partners in the task and the representatives of TISPOL council members a draft of a country document with all the collected information was developed for each of the six participating Member States.

The first draft of the country document was then reviewed by the representative of the TISPOL council member together with the PEPPER partner in the specific Member State. The country report was modified on the basis of the reviewers' comments. The country reports were then finalised in meetings between task leader and those involved in data collection.

7.6.3 Structure, contents and use of the CLEOPATRA database

The database - although stored in a relational database - does not follow the usual relational database structure. The content of the database is being stored using a content management system developed for TISPOL and the CLEOPATRA database project based on the open source system called Drupal (<http://www.drupal.org/>). Drupal uses MySQL as a database backend. At present, the database is stored and accessible on the TISPOL website (www.tispol.org). Figure 23 shows the database as presented on TISPOL website.

As such the database does not have the traditional SQL relational database structure. Instead it is organised in a hierarchical fashion using taxonomy terms. Taxonomy terms are simply a heading for collecting related information. A useful analogy in understanding the database structure would be to consider the database as a book entitled "Cleopatra Database", each country would then have a chapter in the book entitled "Finland", "UK" and so on, these chapters would then have sections entitled "General", "Alcohol", etc, with the relevant pages of text organised into each section.

In order to query the database is using a Google mini appliance server which provides textual results based on a user submitted query. Simply stated it is like searching Google but the results only come from the Cleopatra database, the results can be restricted to certain parts of the database. For example, one might search for "tolerance levels" and restrict results to "Finland". By using this structure no specific knowledge of databases is needed to retrieve the information.

Users of the database will mainly be police officers who will very rarely be familiar with databases. The public part of the CLEOPATRA Database is accessible for everyone who will have access to the internet.

The structure of the database is simple and easy to understand. Manuals for software and databases are normally very difficult to understand and normal users will follow the principle of "learning by doing". At the main page of the CLEOPATRA database a short instruction how to use the database and how to search specific issues is given.

The screenshot shows the TISPOL website interface. At the top, there is a navigation bar with links for Search, My Account, Create Content, Admin, and Logout. Below this is the TISPOL logo and the text 'European Traffic Police Network'. A banner on the right reads 'CROSSING BORDERS TO SAVE LIVES'. The main content area is titled 'Cleopatra' and features a dropdown menu for 'Online Database' with options for 1 Europe, 2 Finland, 3 France, 4 Germany, 5 Netherlands, 6 Sweden, and 7 United Kingdom. A search box and a 'Search' button are also present. A message states: 'There are no articles in this category. However there may be articles contained within its subcategories.' At the bottom, there is a 'Headlines' section with several links to news articles.

Figure 24. The CLEOPATRA database as presented on TISPOL's website www.tispol.org.

The general sections are divided into 23 divisions.

1. General
2. Government
3. Transportation
4. Road safety topics
5. Recent changes in traffic regulation
6. References and websites
7. National road safety programme
8. Road safety action program
9. Infrastructure
10. Publicity campaigns
11. Major offences

12. Demerit point system
13. Administrative law for minor offences
14. Offenders
15. Police forces
16. Legislative institutes
17. Law enforcement institutes
18. Legislation and enforcement
19. Sanctions
20. Statistics and infractions
21. Feedback loop
22. Technology
23. Vulnerable road users

Each division is further divided into subdivisions.

The specific sections (alcohol, speeding, seat belts) are divided into 10 divisions

1. Legislation
2. Education
3. Law enforcement
4. Alcohol/ Speed/ Seat belt control activities
5. Statistics and infractions
6. Sanctions
7. Feedback
8. Good practice
9. Infrastructure
10. Technology

Each division is further divided into subdivisions.

7.7 Conclusions

1. There are big differences between Member States in strategic planning and tactical deployment of TLE. This concerns as well general planning principles as specific planning and deployment of the three targeted enforcement areas: speeding, alcohol and seat belts. Identified good practices of strategic planning included e.g. integration of enforcement, education and public campaigns in drink-driving enforcement, and extensive use of speed cameras, implementation of section controls systems and low tolerance threshold in speed enforcement. Good practices concerning tactical deployment included among other things random breath testing, evidential breath testing, and black spot surveillance of speeds.
2. Speed enforcement usually reduces accidents but the effect depends on enforcement method. Visible, fixed speed cameras reduce the number of accidents by 34% (– 25; –42%). The effects of mobile patrolling and mobile/hidden speed cameras are negligible. For stationary, manual and visible speed enforcement, and for composite methods, there are strong tendencies of accident-reducing effects, however insignificant at the 5%-level. In

general, the effects of speed enforcement increase when enforcement is visible and connected to local publicity. The effects are larger for severe accidents.

3. Concerning drink-driving enforcement patrolling has a significant effect on accidents by -8% (-12; -3). The effect of DUI checkpoints is somewhat stronger by a reduction of -15% (-18; -11). The effects varied depending on the country of the study and on study design. Effects were larger when enforcement was connected to publicity.
4. Seat belt enforcement increases wearing rates by 21% during enforcement and by 15% in the period after enforcement has ended. There was no difference between the effects on drivers and on front seat passengers. The effect was larger when enforcement was conducted without signposting and when it was connected to public information.
5. The results concerning the effectiveness of zero BAC limit (in Hungary, the Czech Republic, Slovakia and Croatia) on accidents involving drink-driving compared to countries with higher BAC limit were inconclusive. It seems that the BAC limit has only a minor role in preventing drink-driving. Historical and social context and the level of drink-driving enforcement are more important than the legal BAC limit.
6. Data needs and data collection requirements for monitoring and evaluating the impacts of TLE were outlined. The resulting suggestions concern 1) data about enforcement activities i.e. enforcement performance indicators (EPI), and 2) effects on road user behaviour and accidents, i.e. safety performance indicators (SPI). Adoption of such uniform data collection and storage procedures in all Member States would benefit enforcement authorities on EU, national and regional levels. It would also enable more thorough and larger-scale analysis of the impacts of enforcement.
7. A practical, easy-to-use and transparent method was developed for the prediction of the effects of enforcement on road safety. The two main steps concern the prediction of the effect of enforcement on road user behaviour and the prediction of the change in behaviour on accidents and/or their severity. Even though part of the input probably usually relies on the judgement of the user rather than accurate data or impact functions, it is believed that the resulting effect estimates can promote effective and efficient planning of enforcement.
8. Data describing practical experiences of Traffic Law Enforcement in six Member States was collected and organised into the online CLEOPATRA database. The database contains information on police forces, police operations and police enforcement related research. The focus is on the enforcement of speeding, drink-driving and seat belt use. A small part of the information is restricted to enforcement authorities, but for the most part is available to the general public at the TISPOL website www.tispol.org.

8. DISSEMINATION

8.1 Dissemination policy and actions

Several targets have been set since the beginning of the project in this task. First of all, it was considered important to have a common project corporate image. The first action was to set a project logo. Open call for proposal was made to all project partners and after several proposals, there has been a voting procedure, to come up with the PEPPER logo (see cover page).

Moreover, specific templates were proposed for all project PU documents (Deliverables, Working Papers, Presentations, etc.) which were followed for every official document of the project by all partners, thus having a uniform image of the project documentation.

For the on-line dissemination of the PEPPER results and news, a well structured, user-friendly website has been created (www.pepper-eu.org), which included a variety of PEPPER related useful information (Objectives, Deliverables, Working Papers, Partners, etc.), together with the latest news of the project and all the Public Project Documents. A snapshot of the website can be seen in Figure 24.

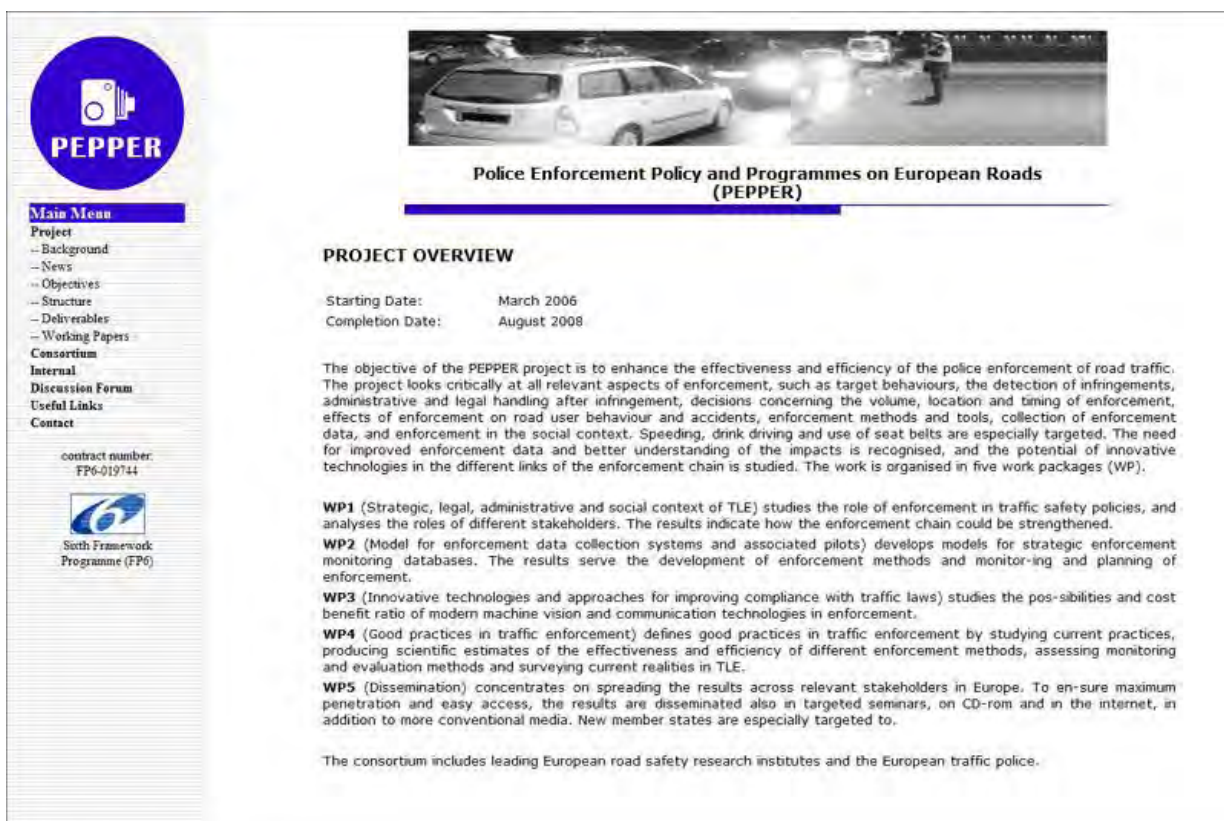


Figure 25. Snapshot of the PEPPER website.

For the broad dissemination of the project and its scopes, leaflets and posters (available at the website) have been created early in the project and have been distributed to all partners for dissemination to any interested parties. The material was designed in a modern and illustrative

way, outlining the aims and objectives of the project, while also indicating the involved partners.

Moreover, the web-site included an “Internal” section, with links to the partners’ ftp server, used for the easy exchange of documents and document storage, as well as to the User Forum area (see §8.3).

Four Newsletters have been produced throughout the duration of the project, including useful information of the up-to-date results as well as upcoming events of the project. The Newsletters were published on the project web-site and disseminated to the User Forum members and, through the project partners, to several other interested parties.

In terms of dissemination of the project results and progress at EU level, several actions have been undertaken, indicatively through organizing informal meetings with EU officials (EC, European Parliament, etc.) on TLE issues, informing Member States through lectures and relevant events, at Police or TLE practitioners’ level, etc.

Finally, in terms of publications, about 18 presentation and papers were produced and have been issued or are foreseen, in National and International Conferences and journals by the project participants. This does not include the presentations at the PEPPER Seminars and Conference, which were another 20. So, in total, there were 38 presentations and papers on the PEPPER project, which is a very satisfactory number for the volume and the duration of the project.

8.2 User Forum

Within PEPPER project, a User Forum has been established, in terms of a group of people, comprising of stakeholders in the field of road safety. The User Forum members were appointed by the project partners or registered through the PEPPER web-site. The 115 members of the PEPPER User Forum have been informed, throughout the duration of the project, of the latest news of PEPPER, they received at priority the PEPPER Newsletters, they were invited in the PEPPER events and, last but not least, they had access to restricted PEPPER results that were not available publicly, through the PEPPER web-site internal area.

In this restricted area, the User Forum Members were able to find restricted PEPPER Deliverables and Working Papers which were not accessible in the public area of the web-site. Each member has his/her personal user name and password with which access is possible to the restricted area. Moreover, a forum, where the User Forum members could discuss any topic of interest and exchange ideas and news in the TLE area, is available in the same place.

8.3 Organisation of Events

A series of official PEPPER dissemination events were organised within the framework of the project. More specifically, two project seminars were held in at the first and the second year of the project as well as a Final Conference towards the project end. In all three events the aim was to invite road safety and TLE stakeholder to participate and learn about the project, its

aims and results, as well as provide input by their valuable experience and discuss Traffic Law Enforcement issues in an open group.

The first PEPPER Seminar was held in Brussels on the 29th April 2007. The Seminar was very successful, attracting the participation of more than 50 experts from several fields related to road safety and enforcement. The aim of the Seminar, to present the preliminary findings of the project and investigate the public opinion on them, was achieved through the presentation of the work performed and on going in each one of the project's work packages, as well as the interesting discussion raised from the topics addressed by the presenters. Of exceptional importance was the presence and speech of the PEPPER Project Officer, Mrs Carla Hess, who represented the EC and gave an overview of the EC's actions in the field of Traffic Law Enforcement.

The second PEPPER Seminar was held in Madrid on the 22nd November 2007. The aim of the Seminar, to disseminate the project concept, diffuse preliminary findings of the project and get feedback and comments from the participants, was reached by presenting results of the project and links to related initiatives, through seven presentations, as well as the raising discussion with the participants on the addressed topics.

The Final PEPPER Conference was held in Prague on the 17th and 18th June 2008. More than 60 participants followed the Conference, which lasted two days. All the major results of PEPPER project were presented and interesting discussion was raised on the addressed topics. Apart from the project results, of utmost interest was also the participation of external speakers, all experts in their fields, who gave very interesting presentations on TLE related issues and applied practices.

Detailed minutes of all three events have been composed and are available on the public PEPPER website, along with the Seminars and Conference presentations.

9. CONCLUSIONS

9.1 Enforcement policy

1. The three major Road Safety policy documents of the EU are: *The White Paper on European Transport Policy*, *The European Road Action Programme*, and the *Commission Recommendation on Enforcement in the field of Road Safety*. The first was a guiding vision and provided a challenging safety target; the second document suggested strategic areas of actions that included harmonizing traffic regulations and upgrading Traffic Policing; and the third document proposed a specific plan about *how* Traffic Policing should be carried out in Member States.
2. Interviews and surveys of politicians, traffic law professionals, other Stakeholders and the general public, suggest wide support for EU safety policies. The strategic goal of halving the number of road fatalities in Europe by the year 2010 is accepted by all institutional stakeholders at the EU level, by Member States and the public. There is a universal recognition that Traffic Law Enforcement has an important role in maintaining legal and safe road user behaviour, but also that it can and must be made more efficient and effective.
3. Most of the practices promoted by the Recommendation – massive speeding control, automated speed enforcement, firm drink-driving control with massive random breath checks, systematic enforcement of safety belt use, cross-border enforcement, use of innovative enforcement technologies – are indeed supported by most stakeholders in all Member States. Compared to studies performed 7–9 years ago there was much wider acceptance of automated speed cameras and not much concern about privacy issues in relation to using such systems.
4. Massive Traffic Policing, as is advocated by the Recommendation, does not come cheaply. Yet, only few Member States allocated special funding for the new, or more massive, policing activities their national safety strategies declared. On the other hand, there are growing trends in the EU to limit the size of police forces dedicated to traffic control.
5. Drink-driving legislation and enforcement practices enjoy strong support from all stakeholders, in each state. There is support for even stronger sanctions against drink-driving. The idea of alcolocks was acceptable to stakeholders who have had some experience with them, but met with scepticism by others.
6. Stakeholders like the idea of increased harmonization of cross-border enforcement, even as they express practical concerns about the functioning of the legal, administrative, and technological machinery needed to make it happen. The support is stronger among professionals from the new EU Member States.
7. There is less agreement, within EU institutions and among professional / institutional stakeholders in Member States, about the legitimacy, feasibility, practicality or desirability, of having a top-down, EU mandated Traffic Law Enforcement policy that

goes into specific tactical issues of “*how to do traffic policing*”, or that requires sharing detailed law enforcement information with external jurisdictions, including an EC agency.

9.2 Current enforcement practices

8. There are differences between Member States in strategic planning and tactical deployment of TLE. This concerns as well general planning principles as specific planning and deployment of the three targeted enforcement areas: speeding, alcohol and seat belts. Identified good practices of strategic planning included e.g. integration of enforcement, education and public campaigns in drink-driving enforcement, and extensive use of speed cameras, implementation of section controls systems and low tolerance threshold in speed enforcement. Good practices concerning tactical deployment included among other things random breath testing, evidential breath testing, and black spot surveillance of speeds.
9. Police forces (especially those dedicated to traffic work) have internal operational guidelines for tactical deployment of personnel, vehicles and equipment for traffic policing tasks. The guidelines are based on accident history, risk assessment, target behaviours and target road-user groups, available resources and the needs of other policing tasks. The deployment plan itself is usually considered a local matter rather than that of a ‘National Enforcement Plan’. It is certainly the case in Federal states and in states with a decentralized system of governance where local authorities and local police forces have a large degree of autonomy.
10. Member States vary considerably in the degree of central management, directed coordination, or willing cooperation among the various organizations involved in the ‘traffic enforcement chain’. Successful implementation of enforcement (or safety management) policies, depends largely on effective cooperation and collaboration mechanisms, irrespective of the nature of governance on the centralization / decentralization dimension. However, decentralised systems seem to have developed more advanced collaboration and other ‘horizontal management’ mechanisms.
11. Police forces are generally interested in adopting new enforcement practices and new technologies for traffic policing. However, the adoption is rarely just a technical issue. It requires changes in strategic level thinking, adaptation of legal systems and modifying management practices.
12. The evidence seems compelling that massive speed control and continuous drink-driving control had a decisive role in bringing down road fatalities in France in the last five years, substantially and relatively quickly. This appears to be a successful, pre-ante, example of the strategy suggested by the EC Recommendation on enforcement. The question is: will the same thing work in more EU states, or in other countries? A related question is: what prevents other countries to follow suit?
13. The French example shows that successful upgrade of a TLE system and general safety management requires the prior availability of institutions capable of handling the upgrading and successfully working out cooperation mechanisms between the many

institutions. In other words, the potential capacity must be there, so that when political leadership is prodded into action there is the legal and administrative bureaucracy, the professional knowledge and skills, the readiness of mass media to promote safety, and the funding to implement whatever the new safety policy is about.

9.3 *Legal and institutional aspects of enforcement*

14. Most traffic law systems in EU countries are a mix of criminal and administrative law. A comparison of countries with criminal traffic law with those having primarily an administrative traffic law, suggests that the nature of the legal system is not a determining factor in the level of road safety in the country.
15. Institutional barriers within the EU, and legal issues regarding EU versus Member States' privileges (such as the subsidiarity principle and 'Pillar' issues), complicate, and sometimes hinder, the definition of EU policy instruments regarding road safety and Traffic Law Enforcement. Once formulated, an EU regulation (or recommendation) has not assured implementation in Member States because of the inherent difficulties, in all states, in the process of transposing the EU law into a functioning National law.
16. In many of the EU states there are institutional barriers between and within ministries, between central and local authorities or between various police forces, which impede adoption of a coherent new Traffic Law Enforcement policy and its efficient implementation.
17. Legal and administrative barriers for efficient and effective implementation of innovative cross-border enforcement systems exist at the EU and at national levels. These barriers include technical (lack of an EU type approval mechanism), institutional (who will be the agencies responsible for implementation, operation, updating and maintenance) and legal barriers (caused by privacy issues insufficiently covered in national law or restricted by national law, e.g. driver vs. owner/keeper responsibility). Such barriers should be addressed and removed jointly by EU policy makers and member states.

9.4 *Enforcement data availability and future needs*

18. There are large variations between countries in the availability of enforcement data, but the common situation is that the available information is limited. Many data elements do not exist or are considered confidential. Furthermore, data have to be collected from several sources and are often stored in different formats and media. Consequently, national detailed data about police deployment plans (and actual implementation) regarding enforcement of speeding, drink-driving and safety belt are simply not available in most states.
19. A conceptual model for European TLE database was outlined. It will fulfil most output needs specified by the Recommendation on enforcement. However, a survey of the needs of national and regional authorities and research organisations should be conducted to make sure that the database would be useful to all relevant users and future enforcement issues. .

20. Input to the database should contain quantitative information on planned and actual enforcement activities e.g. by enforcement target and method the number of checked vehicles, number of detected violations and issued sanctions.
21. The database should be capable of handling differences in legislation, sanctions and the organisation of police enforcement forces between Member States.
22. Some states (e.g. France, Norway, The UK, The Netherlands, Spain and Finland) have started instituting systematic collection of traffic and road user behaviour measures as well as performance indicators for assessing the extent and efficiency of traffic police activity. Such measures are virtually non-existent for the other elements of the enforcement chain, particularly legislative work, follow-up on citations and the courts.
23. Data needs and data collection requirements for monitoring and evaluating the impacts of TLE in close to ideal situation were outlined. The resulting suggestions concern 1) data about enforcement activities i.e. enforcement performance indicators (EPI), and 2) effects on road user behaviour and accidents, i.e. safety performance indicators (SPI). Adoption of such uniform data collection and storage procedures in all Member States would benefit enforcement authorities on EU, national and regional levels. It would also enable more thorough and larger-scale analysis of the impacts of enforcement.
24. Data describing practical experiences of traffic law enforcement in six Member States were collected and organised into the online CLEOPATRA database. The database contains information on police forces, police operations and police enforcement related research. The focus is on the enforcement of speeding, drink driving and seat-belt use. A small part of the information is restricted to enforcement authorities, but for the most part is available to the general public at the TISPOL website www.tispol.org.

9.5 Application of innovative technologies in enforcement

25. It has been estimated that enhanced enforcement could reduce road accidents fatalities by approximately one third. This potential can be realized with the help of innovative active and passive enforcement systems and technology.
26. Section speed control, where speeding vehicles on a stretch of road are automatically detected, can be regarded as one of the most effective enforcement systems, as it can reduce the proportion of speeding vehicles to less than 1%. If implemented widely in all Member States, the number of traffic accidents that are due to speeding could be significantly reduced. Section speed control not only reduces accidents but it has positive effects on traffic flow, congestion, and on air quality and noise.
27. Alcolock in a car prevents persons whose blood alcohol concentration (BAC) is above the legal limit, from driving. Tests of alcolocks have shown good potential to prevent recidivism on drink driving and reduce frequency of violations and alcohol-related accidents.
28. Tests with automated seat-belt detection system, based on digital camera images, showed that the detection success of an automatic system can be very close to that of a human

observer. Automatic detection of a violation that is not easy to detect in regular traffic policing, could increase the salience of the violation and its detection rate, and consequently improve wearing rates. Since camera based detection of seat belt requires a frontal picture of passengers, privacy issues might be an obstacle for effective use, as in the case of automatic speed enforcement in countries where driver's picture is necessary.

29. Intelligent speed adaptation (ISA), which is an in-vehicle, assisted self-regulation of speed control system, has a promising potential in reducing speeding, and adapting speeds to changing local demands. It is acceptable to a majority of drivers who have had experience with it. There are some obstacles, however, that have to be solved before the system can be implemented on a large scale: costs of in-car and infrastructure equipment, accurate speed limit databases are not widespread, and pilot studies have demonstrated confusion because speed limits varies as a consequence of road maintenance and temporal work zones.
30. Positioning technologies can be widely applied in active and passive enforcement, e.g. speed enforcement, parking area control and congestion charging. In such surveillance and enforcement systems vehicles are identified on the basis of their licence plates or specific electronic identification tags, and information concerning vehicles and their location (depending on the application also its travelling direction and speed) are transmitted to the control centre, e.g. by employing GPRS or UMTS technology. Ticket or fees are issued automatically.
31. Regarding cross-border enforcement, a common language-independent system for exchange of information regarding vehicles, owners, drivers and infringements need to be established, as suggested and tested in the VERA2 and VERA3 projects. Furthermore, the laws regarding the execution of financial penalties for traffic violations committed in another member state need to be synchronised with the Framework Decision on the mutual recognition of financial penalties.

9.6 The effects of speed, drink-driving and seat belt enforcement

32. The knowledge of the effects of enforcement on the three focus areas – speeding, drink-driving and seat belt use – was updated by applying meta-analysis to previous studies on the subject.
33. Speed enforcement usually reduces accidents but the effect depends on enforcement method. Visible, fixed speed cameras reduce the number of accidents by 34% (95% confidence interval – 25; –42%). The effects of mobile patrolling and mobile/hidden speed cameras are negligible. For stationary, manual and visible speed enforcement, and for composite methods, there are strong tendencies of accident-reducing effects, however insignificant at the 5%-level. In general, the effects of speed enforcement increase when enforcement is visible and connected to local publicity. The effects are larger for severe accidents.
34. Concerning drink-driving enforcement patrolling has a significant effect on accidents by -8% (-12; -3). The effect of DUI checkpoints is somewhat stronger by a reduction of -15%

(-18; -11). The effects varied depending on the country of the study and on study design. Effects were larger when enforcement was connected to publicity.

35. Seat belt enforcement increases wearing rates by 21% during enforcement and by 15% in the period after enforcement has ended. There was no difference between the effects on drivers and on front seat passengers. The effect was larger when enforcement was conducted without signposting and when it was connected to public information.
36. The results concerning the effectiveness of zero BAC limit (in Hungary, the Czech Republic, Slovakia and Croatia) on accidents involving drink-driving compared to countries with higher BAC limit were inconclusive. It seems that the BAC limit has only a minor role in preventing drink-driving. Historical and social context and the level of drink-driving enforcement are more important than the legal BAC limit.
37. A practical, easy-to-use and transparent method was developed for the prediction of the effects of enforcement on road safety. The two main steps concern the prediction of the effect of enforcement on road user behaviour and the prediction of the change in behaviour on accidents and/or their severity. Even though part of the input may rely on the judgement of the user rather than accurate data or impact functions, it is believed that the resulting impact estimates can promote effective and efficient planning of enforcement.

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11. ANNEXES

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Annex I

List of Deliverables and Working Papers

All Deliverables and Working Papers not marked as *Restricted distribution* are available for downloading at www.pepper-eu.org.

Deliverables

1. Martinez Gil, M.J. & Malenstein, J. 2007. Innovative technology for monitoring traffic, vehicles and drivers. PEPPER Deliverable 1.
2. Zaidel, D., Jayet, M-C., Malenstein, J. & Quimby, A. 2008. The role of Traffic Law Enforcement policies in National and EU Road Safety Strategy. PEPPER Deliverable 2.
3. Malenstein, J. 2008. Approaches and implications of new technologies for European cross-border traffic enforcement. PEPPER Deliverable 3.
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- 4.b Kallberg, V-P. & Ewert, U. 2008. Method for the prediction of the effects on safety of traffic enforcement measures. PEPPER Deliverable 4b.
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Annex 2

Abstracts of Deliverables and Working Papers

Deliverables

1. Martinez Gil, M.J. & Malenstein, J. 2007. Innovative technology for monitoring traffic, vehicles and drivers. PEPPER Deliverable 1. Available at www.pepper-eu.org.

Deliverable 1 “Innovative technology for monitoring traffic, vehicles and drivers” gives a broad overview of the most relevant enforcement technologies and systems used today and the potentialities envisaged for those to be deployed in the near future. Enforcement data and technological system implementations from different perspectives are presented following a structure that first classifies the technologies for their use as surveillance, monitoring and control of driver behaviour and for enforcement itself. A special emphasis is given to the possibility of relying on information systems in order to support and warn about enforcement activities. The deliverable focuses on the three main infractions highlighted by the EU Recommendations (Speed, Drink-driving and Seat belts Use) across the road network. More thorough analysis of the effects of technologies considered particularly relevant is also provided.

2. Zaidel, D., Jayet, M-C., Malenstein, J. & Quimby, A. 2008. The role of Traffic Law Enforcement policies in National and EU Road Safety Strategy. PEPPER Deliverable 2. Available at www.pepper-eu.org.

This report is based on work carried out in WP1 Task 1.1 of the PEPPER project, addressing strategy / policy issues of Traffic Law Enforcement (TLE). It is based on interviews with high level officials in EU Member States and EU institutions, survey questionnaire in several countries, and reviewing literature in print or on the web. It describes the policy making process at the EU level, identifies the main actors in the Transport and TLE areas in EU institutions and describes the evolution of an EU TLE policy out of the general Road Safety Policy. It then provides an analysis and reframing of the Recommendation on Enforcement, which provides a framework for analysis of the role of TLE in National Road Safety plans of EU Member States. The reality of TLE is shown to be much more complex than the idealized description of the enforcement chain. Barriers to planning and implementing Road Safety and TLE policies are described at EU and National levels. Detailed examination of TLE policy process and practice in three states, demonstrates the priority of management mechanisms and skills over the specific organizational structure of policing.

3. Malenstein, J. 2008. Approaches and implications of new technologies for European cross-border traffic enforcement. PEPPER Deliverable 3. Available at www.pepper-eu.org.

PEPPER Deliverable 3 presents the technology issues that are emerging at the brink of EU institution of cross-border enforcement. Each Member State has its own proprietary IT solution to record, process and send TLE data between police, public prosecutor and courts. The technology challenge is to develop and implement a common denominator that can capture all these in-house data and can communicate these to the appropriate authorities in an efficient and

language independent manner across the borders of the EU Member States. Receiving parties/Member States have to be absolutely confident that the received data is reliable, secure, and safe and can be used without any further burden of proof. The objective is to provide an overview and some conclusions that can be used by policy makers, like the EU and the Member States, on implementing cross-border enforcement. Main implication is that a standardised IT concept has to be put on top of the national TLE systems, to be organised, managed, and operated in a common EU concept, accepted by all Member States. This can only be achieved if there will be a European legislative instrument that will institutionalise cross-border enforcement. Without such a legislative instrument there will be no progress whatsoever on this IT technology development.

4.a Van Schagen, I., Bernhoft, I.M., Erke, A., Ewert, U., Kallberg, V-P., Skladana, P. 2008. Good practice in data, data collection, and data use for monitoring and evaluating Traffic Law Enforcement. PEPPER Deliverable 4a. Available at www.pepper-eu.org.

This report is the Deliverable of task 4.3a of the PEPPER project. It describes the good practice requirements regarding data, data collection and data use for monitoring and evaluating Traffic Law Enforcement (TLE). The aim is that, eventually, individual police forces/countries put the identified 'good practice' data into a European TLE monitoring database which would allow police forces/countries to learn from the experiences of others; which would allow the EC to monitor/compare the TLE effort and effectiveness in different Member States; which would allow road safety researchers to assess the effects of TLE on a large scale. Based on the literature and theoretical analyses, the Deliverable presents good practice for data, data collection and data storage to monitor enforcement activities (Enforcement Performance Indicators), to monitor behavioural effects (Safety Performance Indicators) and to monitor effects on accidents and accident severity. In addition, the Deliverable discusses the use of these data for cost-benefit and cost-utility analyses, and for effect evaluations. It focuses on the three main areas of PEPPER: drink-driving, speeding and seat belt use.

4.b Kallberg, V-P. & Ewert, U. 2008. Method for the prediction of the effects on safety of traffic enforcement measures. PEPPER Deliverable 4b. Available at www.pepper-eu.org.

A practical method for the prediction of the safety effects of enforcement measures was developed and its use demonstrated by real-life examples. The two main phases of the method concern the prediction of the effects of the measure on road user behaviour and the effects of the change in road user behaviour on accidents or injuries. The method is easy to understand and prediction proceeds step-by-step. The final output of the method is the number of accidents or injuries, which will be prevented if the measure is implemented. Intermediate results concern the definition of target behaviour (such as speeding, drink-driving or non-use of seat belts), estimation of the expected change in target behaviour and the estimation of the type and quantity of target accidents or injuries (for example injury accidents involving drink drivers or fatalities of car drivers and front seat passengers). The calculations can be made by using a simple pocket calculator or spreadsheet programme. All steps in the process are transparent so that recalculation is easy if part of the input data or functions is updated.

5. Peters, H. & Assing, K. 2008. Overview of good practices in strategic planning and tactical deployment of TLE. PEPPER Deliverable 5. Available at www.pepper-eu.org.

This deliverable pictures identified and recommended good practices in Traffic Law Enforcement regarding strategic planning and tactical deployment which were compiled in the PEPPER Task 4.1 "Good practices in strategic planning and tactical deployment of TLE". To achieve this goal an analytical framework was designed. Based on a questionnaire and country related literature reviews good practices had to be identified. Altogether the replies of 11 EU Member States plus Norway and Switzerland could be analysed. The report at first presents a compilation of good enforcement practice in the areas of drink-driving, speeding and seat belt use based on literature and discussions in the task team, then presents an overview of which practices are commonly being applied in the EU Member States, and concludes with a detailed review of practices in the 13 states, including the barriers to implementing the desired strategies and tactics and the potential for overcoming the barriers and further improvement.

6. Larsen, L., Vavakos, V. & Zaidel, D. 2008. Comparison and analysis of traffic Enforcement chains across EU Member States and in relation to EU policies. PEPPER Deliverable 6. Available at www.pepper-eu.org.

The aim of this Deliverable is to describe and compare Traffic Law Enforcement (TLE) systems in the Member States. Focus is on: speeding, drink-driving and non use of seat belts. Data was primarily collected by questionnaires. The main results show that most countries have more or less explicit TLE plans with focus on the three areas included. Action plans are often very generic and data about actual implementation are scarce. Speed limits as well as BAC limits vary between the countries. Random breath testing through alcoholmeters is commonly applied, while blood testing is used as a complementary when the legal evidence is needed for a court. Seat belt use is in general obligatory for all persons, but far from all the countries have consistent enforcement of this measure. In all three areas violation and sanction data are most frequently collected, while data collection on violations by foreign drivers is rather sparse. Publicity campaigns appear to be carried out to various degrees, but the combination of enforcement and campaigns are not always given priority. Mostly, cross-border enforcement is only practiced to a limited degree.

7. Loukopoulos, P. & Forward, .2008. Social support for Traffic Law Enforcement policies and practices within Member States. PEPPER Deliverable 7. Available at www.pepper-eu.org.

This work examines the perceptions, opinions, and concerns of Traffic Law Enforcement professionals, stakeholders and the general public from EU organizations and Member States. The aim was to obtain information related to national policy and strategies, acceptance, EU recommendations, and future plans. In-depth interviews, surveys, media analyses and literature searches were used to this end. The results show that stakeholders and TLE professionals see TLE as having a high priority on the political agenda. The need for effective enforcement was also recognised. Additionally, there was a strong commitment to automated enforcement and the need to complement all enforcement with passive enforcement strategies. Data collection, storage and access needed to be improved if cross-border enforcement was to be improved. Harmonisation was perceived as good only if it did not result in weakened national standards or a single authority overriding national authorities. There was also far less agreement about

what constituted 'best practice' or how effective current practices were. With regard to the public, it would appear that they accept the idea of more traffic police control. However, the attitudes towards TLE varied depending on the offence. Some of the data also suggest that changes in legislation can change people's perception of the offence itself.

8. Jensen, C., Masson, D. & Siren, A. 2008. Database structure for an enforcement data collection system on speeding, drink-driving and restraint systems. PEPPER Deliverable 8. Available at www.pepper-eu.org.

Deliverable 8 is part of the work carried out in PEPPER Task 2.3. Deliverable 8 presents a conceptual model for a TLE data collection system, a model that is build upon the previous work in the WP 2. The present Deliverable is structured as follows: First, the overall approach as well as the challenges in designing a TLE data collection system are being described. Second, a preliminary database model, used as a conceptual tool for designing the data collection system, is presented. Third, the structure for TLE data collection system itself is presented; and finally, conclusions are drawn. The present Deliverable contributes to the task of creating a common database by providing a structure for the design and will hopefully provide the tools needed for well-informed decisions about the future TLE database and data collection. After the PEPPER project, political will as well as consensus about the importance of establishing such a system is needed in order to finally establish a database system for Europe wide TLE data.

9. Erke, A., Goldenbeld, C. & Vaa, T. 2008. Good practice in the selected key areas: Speeding, drink-driving and seat belt wearing: Results from meta-analysis. PEPPER Deliverable 9. Available at www.pepper-eu.org.

The main objective of task 4.2 in the EU-project PEPPER on Traffic Law Enforcement measures has been to give a systematic review of evaluation studies on speed, drink-driving and seat belt enforcement by applying meta-analyses to assess the best estimates of the effects of enforcement measures on accidents and behaviour. The report separates between stationary speed enforcement using laser/radar, mobile patrolling, composite police controls with stationary/visible elements: and speed cameras. The overall accident-reducing effect is 18 % (-23; -13). Of these, mobile patrolling, mobile/hidden speed cameras and stationary speed enforcement "American type" (same unit measures, pursue and sanction the violator) do not have statistically significant effects on reducing the number of accidents. Visible/fixed speed cameras reduce the number of accidents with -34 % (-25; -42) while stationary and visible speed enforcement show a tendency in reducing the number of accidents of 11%, however insignificant (-22; +1). Concerning drink-driving enforcement a distinction between patrolling measures and DUI checkpoints is justified. The former exhibits a significant effect on accidents by -8 (-12; -3), the latter somewhat stronger by a reduction of -15% (-18; -11). Finally, a meta-analysis of seat belt enforcement shows a significant increase in wearing rates of + 21 (during-period) and + 15 % (after-period).

10. Grunnan, T., Vaa, T., Ulleberg, P., Malenstein, J., Zaidel, D., Kauvo, K., Koskinen, K., Stefan, C., Almqvist, S., Tindall, D.W., & Vermaat, P. 2008. Implications of innovative technology for the key areas in traffic safety: speed, drink-driving and restraint systems. PEPPER Deliverable 10. Available at www.pepper-eu.org.

The aim of this Deliverable is to capture the implications of state of the art technology and new technology developments that potentially may affect future Traffic Law Enforcement (TLE) in the EU. The efficiency of existing enforcement methods and implications of innovative technologies with respect to offences that are perceived as highly involved in causing accidents, such as speeding, drink-driving, and the use of restraint systems are evaluated. Where applicable, some information on other systems for Traffic Law Enforcement systems are added (e.g. black box and drowsiness detection- and warning systems). The systems are divided into two different categories, active and passive enforcement, and the document comprises of a short presentation of the system itself and the main implications of the system. The methodology used consists of two parts: a system description of active and passive enforcement systems and a risk evaluation on the introduction of these systems. Both enforcement methodologies described are captured in two annexes at the end of this document as a result of a risk analysis on the issues listed in the matrix. In relation to the introduction of new technology for Traffic Law Enforcement, the main implication for pan EU implementation, the need for a pan European type approval mechanism is described.

11. Gaitanidou, E. Bekiaris, E., Kauvo, K. & Spanidis, P. 2008. A conceptual model concerning the deployment of positioning and location technology in traffic surveillance and enforcement PEPPER Deliverable 11. Available at www.pepper-eu.org.

In Deliverable 11 an attempt is being made to define a conceptual model for the deployment of positioning and location technologies for the needs for traffic surveillance and enforcement. Four areas of focus have been selected (city center circulation permission, speeding, parking area permission and one-way road violation). For these systems, research has been performed to identify relevant existing applications, and indicative existing systems are presented hereunder. Moreover, preliminary system architecture has been proposed, defining the equipment needs and the flow of data from detecting the violation, to identifying the vehicle that has committed it and issuing the fine. The risks that the implementation of this kind of applications would imply have been identified and ranked, using the FMEA methodology. Four categories of risks have been included: behavioural, technical, legal and organisational risks. A group of experts from the PEPPER Consortium has identified and ranked these risks and the results of the analysis are reported in the present Deliverable. Finally, a conceptual model has been defined, indicating the necessary steps to be taken for the effective deployment of the positioning and location technologies in traffic surveillance and enforcement. The main involved actors have been identified and their roles and responsibilities preliminary defined.

12. Gaitanidou, E. & Bekiaris, E. 2008 Conceptual model for the European Traffic Law Enforcement database. PEPPER Deliverable 12. Available at www.pepper-eu.org.

Deliverable D12 aims at defining the conceptual model for an EU level Traffic Law Enforcement (TLE) monitoring database. First, research was performed to identify and analyse existing databases at EU level, mainly accident databases. Then, within the context of the

PEPPER project, and WP2 in specific, a survey was conducted regarding data availability in the Member States, which resulted in founding many gaps and inconsistencies. A questionnaire survey made in order to investigate the views of relevant experts. Regarding data collection, the main findings of the relevant PEPPER Deliverable 8 are mentioned here as part of the overall conceptual model. Regarding data needs, the views of the European Commission and relevant actors are included here following the consultation process after the Recommendation on Enforcement in the field of road safety. Additionally, within PEPPER, a set of enforcement performance indicators have been selected, constituting the basis for the construction of a future EU-level database. Concluding from the above, the conceptual model is being described here as a step-by-step procedure, specifying the needs in terms of the establishment of the database, the definition of the contents and the data collection process, the organisational framework and the functionality of the proposed EU-level TLE monitoring database.

13, 14 & 15. Kuijten, C., Quimby, A., Kallberg, V-P., Assing, K., Cauzard, J-P. & TISPOL representatives from Finland, Germany, Sweden, France, UK, Netherlands. 2008. Database to assist traffic police forces in the EU Member States. PEPPER Deliverable 13. Available at www.pepper-eu.org.

This report contains information on the good practice database that can be found at the TISPOL website (www.tispol.org). The database provides information on several aspects of road safety more specifically focussed on police and police enforcement. Information is collected from 6 EU Member States with a relatively good policy on road safety and where police forces are known for rather effective and efficient methods to enforce traffic laws in general and more specific the legislation on speeding, seat belt wearing and alcohol. Police specialists and representatives of research institutes in the selected Member States have answered a specific questionnaire and after analysing the answers the representatives of the selected countries are interviewed based on the received answers. A demonstration of good practice related to alcohol speeding and seat belt enforcement is performed and used as input for the database. ETSC is asked to comment a document with relevant issues from an EU perspective to be embedded in the database. After these activities all retrieved information is placed in a database (CLEOPATRA) at the TISPOL website. Over 95% of the content of the database is available at the public part of the TISPOL website. A limited number of sections is only available for TISPOL members. Information in these sections is considered as available for police only.

16. Gaitanidou, E. & Janitzek, T. 2008. Dissemination activities report. PEPPER Deliverable 16. Available at www.pepper-eu.org.

The PEPPER Dissemination policy and actions as planned and realized throughout the project duration are reported in the present Deliverable. The project participants have undertaken several actions in terms of dissemination of the PEPPER results both to the public and related expert groups. First of all, about 40 publications have been realised in term of papers and/or presentations in several events of national or international audience. Secondly, a PEPPER User Forum has been formed, in which more than 100 experts from the fields of Traffic Law Enforcement and road safety have participated and who have been kept up to date with the project results, events and news. In parallel, a project web site (www.pepper-eu.org) has been operating since the beginning of the project and has continuously been updated, where all information about the project can be found, along with the PEPPER public documents. 4

Newsletters have been created and disseminated to the user forum and other interested parties, as well as published on the PEPPER web-site. Last but not least, the project progress and results have been communicated to EC stakeholders in various occasions.

17. Kallberg, V-P., Zaidel, D., Vaa, T., Malenstein, J., Siren, A. & Gaitanidou, E. 2008. Final Report of project PEPPER. PEPPER Deliverable 17.

The project PEPPER (Police Enforcement Policy and Programmes on European Roads) aimed to contribute to the efficiency and effectiveness of traffic law enforcement on EU roads. While the focus of the project was on traffic policing, the whole enforcement chain was examined—from policy choices about the role of police in road safety, through traffic law making, traffic police enforcement practices and the handling of driving offences by the courts. The focus of the project was on the enforcement of speeding, drink-driving and use of seat belts. With regard to these unsafe behaviours, more detailed analyses were made of the planning and implementation of their actual enforcement across member states, the potential of new technologies to support better enforcement and improved compliance, and of the conditions and means to disseminate good practices for effective traffic policing. The availability of enforcement data in Member States was surveyed and suggestions were made concerning uniform, EU-wide enforcement data collection methods and databases. Innovative technologies in Traffic Law Enforcement were described and their potentials assessed, including the applications regarding cross-border enforcement. Good practices were described concerning strategic planning and tactical deployment in traffic law enforcement as well as collection and use of enforcement data for monitoring and evaluation purposes. The knowledge of the effects of enforcement in key areas was updated by applying meta-analysis to previous studies.

Working Papers:

1. Akkermans, L. & Orozova-Bekkevold, I. 2007. Review of main conclusions of completed relevant projects. PEPPER Working Paper 1. Available at www.pepper-eu.org

Working Paper 1 contains a review of the main conclusions and findings of completed and ongoing projects that are related to law enforcement and Traffic Law Enforcement as well as a preliminary list of variables and indicators that can be used to assess Traffic Law Enforcement (TLE) efficiency for the key fields of speeding, drink-driving and the use of restraints in vehicles. The objectives of this paper are the presentation of relevant information concerning Law Enforcement from both the EC Recommendations of October 21st, 2003 on enforcement in the field of road safety as well as literature regarding traffic safety and other fields of interest, the identification of groups of stakeholders in the field of TLE and an overview of variables and indicators that could be used to assess TLE-efficiency. A literature review was performed on literature available from both past and present EU projects as well as literature from other institutions that are linked with law enforcement. The findings are that an extensive amount of literature is available and can be combined in a large questionnaire. The practical usability of such a questionnaire was questioned however and slimming down needs to be considered.

2. PEPPER leaflets and poster. PEPPER Working Paper 2. No abstract.
3. PEPPER website www.pepper-eu.org. PEPPER Working Paper 3. No abstract.
4. Vavakos, V. & Papaioannou, P. 2007. Pilot study: Guidelines for the collection of Traffic Law Enforcement (TLE) information. PEPPER Working Paper 4. Restricted distribution.

The present working paper contains guidelines for the collection of the necessary Traffic Law Enforcement (TLE) information from all the European Member States, for comparison reasons and documentation of information gaps. A uniform methodology for data collection is proposed, which utilizes existing sources of information from literature, in combination with one or more interviews based on a questionnaire. Emphasis is given to the collection of information regarding elements of planning, monitoring and evaluation, automated methods for violation registration, legal and administrative background, information campaigns and the awareness and trend of Member States to coordinate / converge with the relevant Commission Recommendation (2004/345/EU). Three countries: Czech Republic, Greece and Poland have been selected for the pilot testing. The pilot tests have been carried out in July and August of 2006. Regarding the availability of information requested by the Standard Form of the EC Recommendation, Czechia seems to be closer to satisfying the EC requirements. Some of the information is available in Poland and very little in Greece. The methodology was quite successfully pilot tested in the three Member States and the experience gained was utilized for streamlining the whole information collection methodology and the present guidelines.

5. Akkermans, L., Vavakos, V. & Orozova-Bekkevold, I. 2007. Availability of information in a representative sample of Member States. PEPPER Working Paper 5. Available at www.pepper-eu.org

Goal of Working Paper 5 is the description of the availability of data in four EU Member States in the field of enforcement for the target areas of speeding, drink-driving and restraint use. Information was gained by interviewing key persons from police forces, justice departments, etc. This availability information will be used to make a selection of variables and indicators suitable for the description of the effectiveness of enforcement actions. The main finding is that each country presents a very unique picture. It was found that a limited amount of information is available and is usually scattered in different departments. The most information was found for speeding but even then less than halve of the wanted information could be found. For restraint use virtually no information could be found. Problems exist regarding "Public Availability" because of the sensitivity or confidentiality of information. If the issue is not resolved by the end of the information collection time period, the information should be considered unavailable. Cooperation from the board of directors of involved departments from public bodies (police, justice department, etc.) is necessary in order to gain access to the databases containing information regarding TLE. Furthermore, the need for information registration regarding the type approval of the method and instruments used for automated applications is mentioned.

6. Malenstein, J. 2007. Status of task 3.1 Innovative technology for monitoring traffic, vehicles, and drivers (October 2007). PEPPER Working Paper 6. Restricted distribution. No abstract.
7. Peters, H. 2007. Status of task 4.1 Good practices in strategic planning and tactical deployment of TLE (October 2007). PEPPER Working Paper 7. Restricted distribution. No abstract.
8. Vaa, T. 2007. Status of task 4.2 Good practice in the selected key areas: Speeding, drink-driving and seat belt wearing (October 2007).. PEPPER Working Paper 8. Restricted distribution. No abstract.
9. Kuijten, C. 2007. Status of task 4.4 An in-depth survey at police forces in selected countries to identify the current realities of TLE in the European Union (October 2007).. PEPPER Working Paper 9. Restricted distribution. No abstract.
10. Gaitanidou, E. 2007. Electronic Newsletter 1. PEPPER Working Paper 10. No abstract. Available at www.pepper-eu.org.
11. Malenstein, J. 2007. EU policies on Traffic Law Enforcement, Road Safety and Mobility. PEPPER Working Paper 11. Restricted distribution.

The context for the PEPPER project is created in WP1, Strategic, legal, administrative and social context of Traffic Law Enforcement (TLE) in Member States. It examines European transport safety strategies and policies and the ways traffic enforcement is integrated into traffic safety work. This paper addresses EU policies on TLE in Road Safety and mobility, looking at directives, standards, recommendations, bodies, groups, at the EU level, with special attention to the areas of drink-driving, speeding, use of restraint systems, and cross-border enforcement. The paper identifies EU level standards, directives, recommendations, other policy instruments, and statements regarding road safety and enforcement. It also identifies EU level policy makers, administrators, institutions, offices, agencies involved in developing, setting, interpreting, and implementing TLE related policies and EU level organizations, advisory groups, research work-groups, task-forces, etc. that participate in, or influence the formulation of TLE policies [narrower definition than stake-holders]. Relevant documentation from the above sources has been collected and a first analysis of EU policies on TLE in Road Safety has been carried out. Attention is paid to specific TLE issues and some first conclusions on TLE policy on the EU level are stated.

12. Orozova-Bekkevold, I., Martinez, M. & Akkermans, L. 2007. Needs and objectives of the EC regarding TLE data in the light of data availability and the technical aspects of data collection and exchange. PEPPER Working Paper 12. Available at www.pepper-eu.org.

Working Paper 12 “Needs and objectives of the EC regarding TLE data in the light of data availability and the technical aspects of data collection and exchange” discusses the needs and objectives of EC regarding TLE data, taking into consideration the availability of TLE data and the technical aspects of data collection and exchange. The 12 EC Recommendations (2004/345/EC) are briefly discussed in the light of the information on the availability of enforcement data gathered in four Member States (Belgium, Denmark, Greece and Spain). It

was found that TLE data are often considered sensitive, especially information about court procedures and court decisions. It should be stressed that these findings reflect the situation only in the four “test” countries (Belgium, Denmark, Greece and Spain), but not the common EU situation. The enforcement data collection is analysed from a technical point of view as well. Examples on automated speed enforcement systems are provided for four countries: Spain, France, the Netherlands and Norway. Gathering and exchange of TLE information within and between Member States must be improved. A panEuropean data collection system has to deal with a large diversity of data types, volumes and data processing systems.

13. Gaitanidou, E. 2007. Report on 1st PEPPER seminar. PEPPER Working Paper 13. Available at www.pepper-eu.org.

The first PEPPER Seminar was held in Brussels on the 29th April 2007. The Seminar was very successful, attracting the participation of more than 50 experts from several fields related to road safety and enforcement. The aim of the Seminar, to present the preliminary findings of the project and investigate the public opinion on them, was achieved through the presentation of the work performed and on going in each one of the project’s work packages, as well as the interesting discussion raised from the topics addressed by the presenters. Of exceptional importance was the presence and speech of the PEPPER Project Officer, Mrs Carla Hess, who represented the EC and gave an overview of the EC’s actions in the field of Traffic Law Enforcement.

14. Zaidel, D., Quimby, A. & Jayet, M-C. 2008. Traffic Law Enforcement policies and national road safety plans in EU states. PEPPER Working Paper 14. Available at www.pepper-eu.org.

This report is based on work carried out in WP1 Task 1.1 of the PEPPER project. WP1 addressed strategy / policy issues of Traffic Law Enforcement (TLE) in the context of Road Safety policies. This W14 report is of Task 1.1 part 2, which examines how TLE is represented in National Road Safety Programs and how the practice of TLE in each state is linked to National Road Safety plan or to other explicit traffic policing strategies. The report is based on interviews with top level road safety or police officials in some EU states, survey questionnaires in other countries, and reviewing literature in print or on the web. A reframing of the Recommendation on Enforcement provides a framework for analysis of the role of TLE in National Road Safety plans of EU Member States. The reality of TLE is shown to be much more complex than what is perhaps presumed in the Recommendation. Barriers to planning and implementing Road Safety and TLE policies are described. Detailed examination of TLE policy process and practice in three states, demonstrates the priority of management mechanisms and skills over the specific organizational structure of Police and other government institutions.

15. Cauzard, J.P. , Skladana, P., Vaucher, S., Zaidel, D. & Quimby, A. 2008. Public perceptions and opinions regarding TLE in EU Member States. PEPPER Working Paper 15. Available at www.pepper-eu.org.

This working paper examines the perceptions and opinions of the public regarding the application of law on road traffic in the Member States. The objective is to obtain information relating to national policy and strategies, acceptance, EU recommendations, and future plans to provide the necessary background for further work to promote new methods for improving

road safety. Documents relating to public opinion (Czech Republic, Switzerland, France, United Kingdom and Israel) and an analysis of media (Czech Republic) were used for this purpose.

16. Gaitanidou, E. 2007. Electronic newsletter 2. PEPPER Working Paper 16. No abstract. Available at www.pepper-eu.org.
17. Loukopoulos, P. & Forward, S. 2007. Opinions and concerns of TLE professionals in EU organizations and Member States. PEPPER Working Paper 17. Restricted distribution.

This work examines the perceptions, opinions, and concerns of Traffic Law Enforcement professionals from EU organizations and Member States. The aim was to obtain information related to national policy and strategies, acceptance, EU recommendations, and future plans, so as to provide the necessary background for later work aiming to promote new methods for the improvement of road safety. In-depth interviews (Czech Republic, Finland, France, Lithuania, Poland, and Sweden) and a media analysis (Sweden) were used to this end. Contrasting previous work, road safety was seen to have become a high priority on the political agenda. Additionally, there was a strong commitment to automated enforcement as well as the need to complement all enforcement with passive enforcement strategies. Data collection, storage and access needed to be improved if cross-border enforcement was to be improved. Harmonisation was perceived as good only if it did not result in weakened national standards or a single authority overriding national authorities. Implications for the later stages of PEPPER are that there is good potential for new technologies to strengthen the enforcement chain but that there needs to be improved data collection and harmonisation of enforcement targets and strategies to maximise the return from any such technologies.

18. Gaitanidou, E. & Kauvo, K. 2007. Status of Task 3.3 Conceptual Model for the use of positioning technologies in the tactical planning and deployment of traffic surveillance. PEPPER Working Paper 18. Restricted distribution. No abstract.
19. Peters, H. 2007. Status of Task 4.1 Good practices in strategic planning and tactical deployment of TLE. PEPPER Working Paper 19. Restricted distribution. No abstract.
20. Vaa, T. 2007. Status of Task 4.2 Good practice in the selected key areas: Speeding, drink-driving and seat belt wearing. PEPPER Working Paper 20. Restricted distribution. No abstract.
21. Kallberg, V-P, & Van Schagen, I. 2007. Status of Task 4.3 Good practice in monitoring, evaluating and predicting the impacts of TLE on behaviour and accidents. PEPPER Working Paper 21. Restricted distribution. No abstract.
22. Kuijten, C. 2007. Status of Task 4.4 An indepth survey at police forces in selected countries to identify the current realities of TLE in the European Union. PEPPER Working Paper 21. Restricted distribution. No abstract.
23. Kallberg, V-P. & Ewert, U. 2007. Framework for the prediction of the effects of road traffic enforcement measures. PEPPER Working Paper 23. Available at www.pepper-eu.org.

The first development version of a framework for the prediction of the effects on accidents of Traffic Law Enforcement measures is described. It should provide a rough estimate of the expected effects on accidents or injuries. The prediction process involves the following main stages: a) selection of target behaviour, b) definition of enforcement measure, c) definition of the expected effect on road user behaviour, d) definition of the expected percentage change in accidents or injuries resulting from the change in behaviour, e) definition of the baseline number of accidents or injuries, f) calculation of the effect on the number of accidents or injuries, and g) assessment of the uncertainty of the results. The framework is meant to be easy to use by those who make enforcement plans and approve them. It suits best for the prediction of the effects of large scale measures or enforcement campaigns. All data and calculations are presented in a transparent way.

24. Van Schagen, I., Bernhoft, I.M., Erke, A., Ewert, U., Kallberg, V-P., Skladana, P. 2007. Good practice in data and data collection for monitoring and evaluating Traffic Law Enforcement. PEPPER Working Paper 24. Available at www.pepper-eu.org.

This Working Paper describes the good practice requirements regarding data and data collection for monitoring and evaluating Traffic Law Enforcement (TLE). The aim is that, eventually, individual police forces/countries put the identified 'good practice' data into a European TLE monitoring database which would allow police forces/countries to learn from the experiences of others; which would allow the EC to monitor/compare the TLE effort and effectiveness in different Member States; which would allow road safety researchers to assess the effects of TLE on a large scale. Based on the literature and theoretical analysis, the working paper presents good practice for data, data collection and data storage to monitor enforcement activities (Enforcement Performance Indicators), to monitor behavioural effects (Safety Performance Indicators) and to monitor effects in accident and accident severity. It focuses on the three main areas of PEPPER: drink-driving, speeding and seat belt use.

25. Larsen, L., Vavakos, V. & Zaidel, D. 2007. Description of Traffic Law Enforcement systems in EU Member States. PEPPER Working Paper 25. Restricted distribution.

The aim of this Working Paper is to describe the Traffic Law Enforcement (TLE) chain in the Member States. Focus is on the three offences with the highest accident risk reduction potential: speeding, drunken driving and non use of seat belts. Data was primarily collected by questionnaires. The main results show that most countries have more or less explicit TLE plans with focus on the three areas included. Action plans are often very generic and data about actual implementation are scarce. Speed limits as well as BAC limits vary between the countries, Random breath testing through alcometers is commonly applied, while blood testing is used as a complementary when the legal evidence is needed for a court. Seat belt use is in general obligatory for all persons, but far from all the countries have consistent enforcement of this measure. Violation and sanction data are most frequently collected, while data collection on violations by foreign drivers rather sparse. Publicity campaigns appears to be carried out to various degree but the combination of enforcement and campaigns are not always given priority. Mostly, cross-border enforcement is only practiced to a limited degree.

26. Orozova-Bekkevold, I., Akkermans, L. & Meng, A. 2007. Description of Enforcement Performance Indicators selected. PEPPER Working Paper 26. Available at www.pepper-eu.org.

A set of Enforcement Performance Indicators (EPI) that can be used for the analysis of the efficiency of the Traffic Law Enforcement (TLE) chain is selected. The EPI were selected among the TLE data recommended by the European Commission (2004/345/EC) using information on TLE data availability and guidelines on good practice for data collection. The selected EPIs describe the current legislation and enforcement activities in the key areas of drink-driving, speeding and restraint use. It should be stressed that this set of EPIs reflects the current practices of enforcement and TLE data registration and collection, which may differ by the good practices recommended by task 4.3a. The proposed set consists of 16 EPIs for speed, 17 for drink-driving and 15 for restraint use enforcement. The advantage of the set of EPI selected in this working paper is that most of the needed data are available in many of the Member States. This means that the indicators can be created (or estimated) and used almost immediately, or in the very near future. The concrete values of the EPIs are not given here, since the pilot data collection is not yet completed (it is expected to ready by October 2007).

27. Gaitanidou, E., Linaras, C. & Akkermans, L. 2007. Structure of enforcement database. PEPPER Working Paper 27. Available at www.pepper-eu.org.

In the present Working Paper, the first attempt for the definition of a conceptual model for the European Traffic Law Enforcement monitoring database is presented. The document includes an approach on the basic content that a TLE database should include, as well as a comparative analysis of the questionnaires' templates, used by the different Tasks of the PEPPER project in order to gather data referring to the different areas of Traffic Law Enforcement (TLE) in several EU countries. The aim of the comparative analysis is to detect the commonalities of these templates and possibly group them accordingly. As a second step, the draft specifications and the preliminary structure of the database are being defined hereunder. The technical specifications are reported and a first layout and structure are being suggested, to be further developed and finalised during the next steps of Task 2.4, as defined at the end of the document.

28. Kuijten, C. 2007. Status of Task 4.4 An indepth survey at police forces in selected countries to identify the current realities of TLE in the European Union. PEPPER Working Paper 28. Restricted distribution. No abstract.
29. Siren, A., Meng, A. & Orozova-Bekkevold, I. 2007. List of enforcement data to be collected. PEPPER Working Paper 29. Available at www.pepper-eu.org.

The purpose of Working Paper 29 is to provide a list of enforcement data to be collected in the pilot data collection. The selection of the data to be collected is based on the work conducted in task 2.1. and the previous working papers (W1, W5, and W12). The outcome of the selection process is the questionnaire that will be used to collect the data. The questionnaire is included to the present working paper as an annex.

30. Gaitanidou, E. 2007. Electronic newsletter 3. PEPPER Working Paper 30. No abstract. Available at www.pepper-eu.org.
31. Filemonova Rocakova, P., Quimpy, A. & Zaidel, D. 2008. Opinions of stakeholders about Traffic Law Enforcement (TLE) policy and practice. PEPPER Working Paper 31. Available at www.pepper-eu.org.

This Working Paper describes the opinions and perceptions of a range of stakeholders towards Traffic Law Enforcement (TLE) in a small sample of European countries (the United Kingdom, the Czech Republic, Sweden, Greece and Poland). The findings are based on in-depth interviews held with a variety of professionals, some in decision making positions and most of whom are not involved directly in traffic policing. The interviews sought to obtain the personal views on police enforcement policies and practices regarding speeding, drink-driving, seat belt use, advanced technology, cross-border traffic, and attitudes towards EU harmonisation and Directives in the area of TLE. The findings – qualitative rather than quantitative in nature – revealed a wide range of opinions, both positive and critical in nature. The need for effective enforcement was universally recognised, particularly in the areas of speeding, drink-driving and seat belt wearing. There was far less agreement about what constituted ‘best practice’ or how effective current practices were. The state of economic development, unique socio-cultural attributes and the current status of technological devices, were some of the factors mentioned as influencing the actual intensity and impacts of traffic policing. The same factors play a role in the level of support for harmonization and EU- lead traffic regulations.

32. Gaitanidou, E. & Janizek, T. 2008. Report on the 2nd PEPPER seminar. PEPPER Working Paper 32. Available at www.pepper-eu.org.

The second PEPPER Seminar was held in Madrid on the 22nd November 2007. The Seminar was very successful, attracting the participation of experts from several fields related to road safety and enforcement. The aim of the Seminar, to disseminate the project concept, diffuse preliminary findings of the project and get feedback and comments from the participants, was reached by presenting results of the project and links to related initiatives, through seven presentations, as well as the raising discussion with the participants on the addressed topics.

33. Vavakos, V. & Papaioannou, P. 2007. Pilot study: Streamlined database constructed with data collected. PEPPER Working Paper 33. Available at www.pepper-eu.org.

The present working paper, produced in the context of Work Package 2 (WP2) “Model for an enforcement data collection system and associated pilots”, describes the procedure used for transferring and storing the data collected from six European countries during the pilot study of WP2, into an organized data file. Data was collected according to a detailed questionnaire, and was originally saved in free text format in the questionnaire file of each country. For the purpose of collecting together and storing of the data, a spreadsheet file (MSExcel) was used, because at present conditions it was considered as the most suitable and flexible tool which allows the storage of a variety of type of answers for the same question, giving the ability to the user to view simultaneously any question together with all the relevant available answers, or to view separately all data collected by any one country. This file will be used as customized and flexible tool in the next steps of this task for the analysis and evaluation of the collected

data. Therefore changes in the content and format of the collected data were deliberately avoided, thus eliminating the limits of “streamlining data into common predefined formats”. The developed data organizing and storing tool is not intended and should not be considered as a model for the European data collection system on TLE.

34. Grunnan, T. 2007. Status of task Task 3.2 Implications of innovative technology for the key areas in traffic safety: Speed, drink-driving and restraint systems. PEPPER Working Paper 34. Restricted distribution. No abstract.
35. Gaitanidou, E. 2007. Status of Task 3.3 Conceptual Model for the use of positioning technologies in the tactical planning and deployment of traffic surveillance. PEPPER Working Paper 35. Restricted distribution. No abstract.
36. Peters, H. 2007. Status of Task 4.1 Good practices in strategic planning and tactical deployment of TLE. PEPPER Working Paper 36. Restricted distribution. No abstract.
37. Vaa, T. 2007. Status of Task 4.2 Good practice in the selected key areas: Speeding, drink-driving and seat belt wearing. PEPPER Working Paper 37. Restricted distribution. No abstract.
38. Kallberg, V-P, & Van Schagen, I. 2007. Status of Task 4.3 Good practice in monitoring, evaluating and predicting the impacts of TLE on behaviour and accidents. PEPPER Working Paper 38. Restricted distribution. No abstract.
39. Kuijten, C. 2007. Status of Task 4.4 An indepth survey at police forces in selected countries to identify the current realities of TLE in the European Union. PEPPER Working Paper 39. Restricted distribution. No abstract.
40. Siren, A., Akkermans, L., Jensen, x & Meng, A. 2008. Evaluation of the data collected in the pilots and a suggestion for the structure of a data collection system. PEPPER Working Paper 40. Available at www.pepper-eu.org.

In WP 2 various information on Traffic Law Enforcement data has been collected in selected European countries. The main body of information was collected in a pilot study where detailed TLE data was requested from 6 EU Member States and Switzerland. The present Working paper evaluates this collected pilot data. It also evaluates the data collection process and analyses the challenges, problems, and barriers encountered while collecting the data. Finally, the present working paper describes conceptual guidelines for a data collection system that could serve as a valuable tool in the future if TLE data is to be collected at a European level.

41. Filemona Rocakova, P. & Eksler, V. 2008. Evaluation of the 0.0 BAC limit for drivers of road vehicles in Czech Republic, Slovakia, Hungary and Croatia. PEPPER Working Paper 41. Available at www.pepper-eu.org.

Drink-driving is one of the most discussed TLE (Traffic Law Enforcement) issues. Why? Firstly, in accordance with culture customs - traditionally, the alcohol consumption is accepted as a part of social life; as well as use cars for moving from place to place. Secondly drink-driving is easy to measure and compare with other causes of accident. The goal of this study was provide understanding of the performance and circumstances of the situation in respect to

DWI in four zero limit countries. The study describes all relevant aspects of the zero g/l BAC limit and assesses its impact on traffic safety. In order to investigate additional background aspects, a questionnaire was distributed and fulfilled by relevant organizations involved in TLE chain. Data gathered included history, legislation, enforcement practices and crash data. The countries with zero limit and those with no-zero BAC limit can be found side-by-side in Europe in terms of their road safety performance. Among the four countries compared, the Croatia performs outstandingly bad. The limit itself plays only a minor role in preventing alcohol related crashes. Historical and social context together with enforcement level are the strongest determinative factors in respect to the prevalence of alcohol in injury crashes.

42. Gaitanidou, E. 2008. Database Specifications. PEPPER Working Paper 42. Available at www.pepper-eu.org.

The European Commission has issued, since 2003, a Recommendation on Enforcement in the field of road safety. This Recommendation suggests, among others, the collection and communication of certain data items on the enforcement activities of the Member States in three areas of interest: speeding, drink-driving and restraint use. The collection of this significant amount of data also implies the necessity of how it is organised so that it can be used effectively. For this purpose, the PEPPER project suggests the creation of an EU level Traffic Law Enforcement monitoring database. Relevant research has been performed to define the specifications for the creation of such a database. The experience of already existing road safety related databases (i.e. accident databases) has been looked into and a questionnaire on the needs for an EU level TLE monitoring database has been structured and sent to relevant stakeholders. Moreover, relevant work that has been done within the project, in terms of selecting Enforcement Performance Indicators and investigating the data availability in certain Member States has been taken into account. The results of the above work are presented in the present Working Paper, to be finalised with the proposal of a conceptual model for a European TLE monitoring database in Deliverable 12.

43. Gaitanidou, E. 2008. Electronic newsletter 4. PEPPER Working Paper 43. No abstract. Available at www.pepper-eu.org.

44. Gaitanidou, E.. 2008. Report on the International Conference. PEPPER Working Paper 44. Available at www.pepper-eu.org.

The Final PEPPER Conference was held in Prague on the 17th and 18th June 2008. More than 60 participants followed the Conference, which lasted two days. All the major results of PEPPER project were presented and interesting discussion was raised on the addressed topics. Apart from the project results, of utmost interest was also the participation of invited speakers, all experts in their fields, who gave very interesting presentations on TLE related issues and applied practices.