## RiPCORD-iSEREST Final Report

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<td>WP1</td>
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<tr>
<td>Deliverable No.</td>
<td>D1</td>
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<tr>
<td>Authors</td>
<td>Weber R., Matena S. (BAST),</td>
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<td>Status</td>
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<tr>
<td>File Name:</td>
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<td>Project start date and duration</td>
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1. Summary

The objective of RiPCORD-iSEREST was to give scientific support to the European transport policy to reach the 2010 transport road safety target by establishing best practice tools and guidelines for road infrastructure safety measures. Further, tools have been established to assess the cost efficiency of different safety measures in order to develop and manage a safe road infrastructure in a cost effective way. In addition, recommendations on the best tools in a specific situation have been worked out.

For accident prediction models, road safety audits, road safety inspections and black spot management best practices have been identified and compiled into best practice guidelines. While the common practice concerning road safety audits and accident prediction models does not differ widely among different states, road safety inspections are applied differently and the definition of best practices seemed difficult. To take the differences into account a “common understanding approach” has been defined. Concerning black spot management apart from different definitions two completely different approaches have been identified, the data based approach and the model based approach. Even within the consortium a common understanding on the best practices was difficult to achieve.

As accident analyses show, most of the casualties on rural roads are caused by run-off-the-road and head-on-collisions on single carriageway roads. Consequently, measures preventing these kinds of accidents have been developed. One of these measures is the concept of self-explaining roads. Recommendations have been worked out on the design of standardised and self-explaining roads.

About half of all road traffic fatalities and injuries in rural areas in Europe occur on secondary roads. These roads are two-lane rural roads not compromised by the primary network which encompasses e.g. multilane freeways and two-lane rural highways with major importance in network function.

Concerning the reduction of the number of accidents on secondary roads, software tools and a handbook as decision support tools for local road authorities have been developed.

The following chapters outline the results of the single work packages of the RiPCORD-iSEREST project.
## 2. Project Partners

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3. Project activities within the work packages

3.1 Work package 1 'Project Management'

The main activities of WP 1 were to co-ordinate the work of all single work packages, to organise the steering committee meetings, to work out the interim-report and the final report of the project and the financial and contractual management.

3.2 Work package 2 'Road Safety Impact Assessment (RIA) and Accident Prediction Model (APM)'

In work package 2 (WP2) of RiPCORD-iSEREST Accident Prediction Models (APM) and Road Safety Impact Assessments (RIA) have been analysed.

- An Accident Prediction Model is a mathematical formula describing the relation between the safety level of existing roads (i.e. crashes, victims, injured, fatalities etc.) and variables that explain this level (road length, width, traffic volume etc.).

- A Road Safety Impact Assessment is a methodology to assess the impact of plans on safety. This can be major road works, a new bridge etc. that may or may not be intended to raise the safety level. A RIA can also concern a wider scheme i.e. be intended to make plans for upgrading the safety level of a total network or area.

Concerning accident prediction models, traffic volumes (vehicles per day) and road lengths (km) are the most important explanatory variables, both for road sections and intersections. The comparison of different field trials points out that the parameters of the model can vary considerably between road types and countries. The reason is that road characteristics can differ considerably and so can road user behaviour, vehicle types etc. It is therefore recommended to make APMs per country and road type and use these to compare the safety level of a road against the value of the APM for the road type and traffic volume under consideration. APMs can thus also play an important role in identifying black spots.

The basic form of nearly all modern accident prediction models is this:

$E(\lambda) = \alpha Q^\beta M e^{\sum \gamma_i x_i}$.

The estimated expected number of accidents, $E(\lambda)$, is a function of traffic volume, $Q$, and a set of risk factors, $x_i$ ($i = 1, 2, 3, ..., n$). The effect of traffic volume on accidents is modelled in terms of an elasticity, that is a power, $\beta$, to which traffic volume is raised. For intersections volumes for the major and minor road are included. The effects of various risk factors that influence the probability of accidents, given exposure, is generally modelled as an exponential function, that is as $e$ (the base of natural logarithms) raised to a sum of the product of coefficients, $\gamma_i$, and values of the variables, $x_i$, denoting risk factors.
The volume and risk factors are the explanatory variables of the model and, ideally speaking, the choice of explanatory variables to be included in an accident prediction model ought to be based on theory. However, the usual basis for choosing explanatory variables appears to be simply data availability. They should include variables that:

- have been found in previous studies to exert a major influence on the number of accidents;
- can be measured in a valid and reliable way;
- are not very highly correlated with other included explanatory variables.

The work in WP2 has given the following insights:

- developing an APM is not an easy task, probably not suited for road authorities with the possible exception of the national level;
- a good and detailed APM requires much data of good quality and detail that is usually not available;
- as a result only a few explanatory variables (risk factors) are included;
- APM can be quite different for the same road type in different countries.

It is recommended that on a national level basic APMs are developed for several road types, depending on the national situation. 'Basic' means that no risk factors are included, only the traffic volume is used. In general the accident numbers will be higher at increasing volumes, but the accident rate will drop.

A customised APM could be used to benchmark a road network. If the expected amount of accidents is significantly lower than what is measured in reality, it is likely that there are some deficiencies in road design. This approach is important in selecting cost effective measures that have apparently been applied on other roads of the same type. It will not necessarily lead to high numbers of prevented accidents because one may select roads with low traffic volumes and, subsequently, low accident numbers, although (much) higher than is usual for this road type. This can easily be overcome by considering only roads with a medium to high traffic volume.

Road Safety Impact Assessment is used for (major) road works, a new bridge, tunnel, etc. This is performed in many countries and in many different ways. Due to the fact that this topic is not often dealt with in the (scientific) literature, best practices concerning RIA could not be worked out.

The final report of WP2 gives recommendations for the way in which these instruments can be used by practitioners. It is based on two earlier published reports regarding the state-of-the-art on APMs and RIAs, and the results of pilot studies. Both are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).
3.3 Work package 3 'Best practice on Road Design and Road Environment'

Main objective of work package 3 of RiPCORD-iSEREST was to collect information on best practices concerning the design of self-explaining and forgiving roads. In order to gain an overview on existing practices on road categorisation and the layout of typical rural roads a questionnaire survey was launched. The results showed that the design of self-explaining roads is not spread widely in Europe although more and more countries include ideas into their practice of road categorisation and road design which are also applied in the few concepts of self-explaining roads.

The survey revealed that mainly three countries have already implemented such concepts or at least started the implementation. Based on the three practical examples and research results, a general recommendation for the design of self-explaining roads has been developed.

Another major issue of the work in work package 3 was to collect information on road design elements which help to reduce the number and consequences of head-on collisions and run-off-the-road accidents. Apart from general design regulations which have already been considered in most national road design guidelines, the most promising design and operational aspects have been included in the concept of self-explaining roads.

This concept bases on the idea that roads with certain design elements or equipment raise certain expectations in road users regarding their own driving behaviour and the attitude of other road users and thus induce appropriate speed or steering manoeuvres. A self-explaining road is therefore a road designed and built in such a way as to induce adequate behaviour. A perfectly designed self-explaining road is able to support motorists in their driving task and reduces the need for local speed limit or warning signs. But the self-explaining road concept is not only intended to influence driving behaviour but should also provide a safe road design in itself. For that reason self-explaining roads are built and operated according to the needs of safe road traffic.

Since even a perfectly designed road cannot prevent all accidents, its roadsides have to be safe in order to avoid serious consequences once a car runs off the road. Crashes with roadside obstacles usually have most severe consequences. Therefore roadsides have to be kept free of obstacles like poles, trees and structures or these obstacles have to be guarded by guard rails.

Gradual speed limits for different road classes as proposed in the concepts contribute to the reduction of accidents as well as the choice of safe cross-section types for high-speed roads.

The examples show that some countries have already started introducing self-explaining road concepts onto their road network. Although there has not been much research about the effects of self-explaining roads on driving behaviour and traffic safety in total, the evaluations of single features of the concepts are promising. As many studies show, especially on high volume roads, 2+1 cross-
sections can significantly reduce head-on collisions while according to Beenker, (2004), on low volume roads the number of injury accidents can be significantly reduced after the introduction of a 2-1 cross-section and a general speed limit of 60 km/h.

What can be concluded is that the introduction of safe cross-section types operated at safe speeds with appropriate intersection types as it is proposed in the concepts of self-explaining roads can contribute to reducing the number of severe road accidents.

One pre-condition for the successful implementation of this concept in Europe is a clear assignment of roads to the self-explaining road types. The analysis of current practice of road categorisation showed that in principle for most European countries a categorisation according to the proposed road types would be possible.

For most countries, however, the application of gradual speed limits according to road classes and layouts rather than general speed limits will be new. In addition to this, the re-categorisation and the re-marking or even redesign of the road network requires time and money. With regard to the length of existing road networks and limited funds, the adaptation of a self-explaining road concept will have to be realised step by step.

The concept of self-explaining roads can be seen as a further step to minimise accidents on the rural road network. Existing concepts should be monitored and evaluated to facilitate a further application of self-explaining roads in Europe.

The final report of WP3 bases on two internal reports on the road categorisation practice in Europe and the reduction of run-off-the-road accidents and head-on collisions and gives recommendations on the design of self-explaining and forgiving roads. All reports are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

### 3.4 Work package 4 'Best practice guidelines on Road Safety Audit (RSA)'

The goal of work package 4 was to work out best practice guidelines on road safety audits which are presented in Deliverable D4. The deliverable bases on three internal reports and summarises and combines practices which have been successfully applied in European countries or abroad. The goals of this report are to inform the reader on the reasons why carrying out audits is beneficial and how to successfully carry out road safety audits. The information provided by these guidelines is deemed to help stakeholders to decide whether the alternatives described in the report suit the given situation in his or her organisation or country.

In addition to technical guidelines, the report also gives recommendations on the auditors' training and the implementation of audits into national practice.

Concerning the cost-effectiveness of road safety measures the results of the Rosebud project have been analysed and compared to frequent deficits which
have been identified in road safety audits. The comparison showed that countermeasures for the typical deficits mostly showed good benefit-cost-ratios (BCR) but also a large variation in the results of single countermeasures.

Whenever road infrastructure safety measures are evaluated, one has to keep in mind that due to different pre-conditions the results are not always transferable to other situations or regions.

What can be concluded is that a large proportion of measures proposed in road safety audits only require small changes within the schemes. These depend, apart from the time spent to change the schemes, on only moderate investments.

In most countries auditors only report the deficits while the designers have the freedom to choose appropriate and cost-efficient measures to rectify them. This enables the road authority and the designers to monitor the extra costs emanating from the audits. Generally, measures which can be applied to all audit situations do not exist. Usually there is more than one possible solution for rectifying a deficit and sometimes in comparable situations different measures have to be applied and adapted to the local conditions. Auditors should know these specific local conditions and their education should enable them to judge these situations correctly and if necessary to consult road authorities and designers with respect to possible countermeasures.

Introduction of road safety audit in a country is a complex task which can also be time consuming. Apart from adapting existing audit procedures and audit tools to the special needs of a country, the general awareness regarding the importance of road safety audit among road authorities is seen as an essential precondition in the implementation process.

Generally, before introducing road safety audit in a country there should be an agreement on some basic issues among the road safety experts concerning the audit process (e.g. procedures, formality, audit stages, responsibilities).

While adapting the audit procedures in a country, the conducting of pilot projects helps to check if the chosen tools fulfil all the necessary needs. The quality of a road safety audit largely depends on the quality of the auditors, so a specific education of the auditors is of great importance.

The results of the project point out that audits should be already carried out during the feasibility stage of a project and should also be carried out in all design stages up to traffic opening. By definition, after opening audits are not real audits. In most current approaches after opening audits are more comparable to quality controls or road safety inspections but can nevertheless be recommended to increase the safety level of new roads.

The final deliverable of WP4 compiles the best practice guidelines on road safety auditing, the training of road safety auditors and the implementation of road safety audits. It is based on three internal reports. The reports D4.1 and D4.3 as well as the final deliverable D4 are available at the RIPCORD-iSEREST website (www.ripcord-iserest.com). Report D4.2 “Draft best practice guidelines on road safety audits” has been replenished and replaced by the final deliverable.
3.5 Work package 5 ‘Best practice guidelines on Safety Inspection (RSI)’

Goal of work package 5 was to collect information on Road Safety Inspections and to identify “best practices”. Road Safety Inspections (RSI) are usually carried out to identify traffic hazards related to the road and the road environment characteristics and propose interventions to mitigate the hazards detected. Developments in the road network may create conflicts between the current function of a road and its intended use, along with inadequacy of equipment and design characteristics to the current use of the road. Furthermore, improvements in road standards may result in discrepancies between characteristics of newly built or reconstructed roads and existing ones, interfering with the establishment of common a priori expectations concerning road use. Due to technological developments and new technical standards existing road equipment may become obsolete and impose its replacement. Once open to traffic, the road environment is likely to be affected by interference not decided upon by road authorities; this is especially relevant concerning roadside characteristics.

These and others are hazardous factors emerging during the lifecycle of a road itinerary and unforeseen in its early stages, i.e. the planning and design stages. Tackling these hazards in order to raise the safety level of existing roads and to bring their standards to adequate consistency with the rest of the road network is the main objective of RSI. A secondary, complementary, objective may also be achieved by RSI: to maintain or restore the original safety level of an existing road. However, it is recognized that several issues related to this secondary objective are mainly achieved by means of regular road maintenance inspections.

In this RiPCORD-iSEREST work package, Road Safety Inspection was defined as:

a. a preventive tool,
b. consisting of a regular, systematic, on-site inspection of existing roads, covering
c. the whole road network,
d. carried out by trained safety expert teams,
e. resulting in a formal report on detected road hazards and safety issues,
f. requiring a formal response by the relevant road authority.

RSI protocols and designations in use vary considerably between different countries. By comparison with Road Safety Audits and Black Spot Management, RSI are one of the least agreed upon safety management practices in Europe.

To this end, best practice guidelines were defined and tested in three countries, leading to the conclusion that there are no major practical impediments to their extensive application in European countries.
Implementation of Road Safety Inspections, however, implies that a number of technical, administrative, regulatory, legal and financial questions have to be solved beforehand, in order to adapt the concept to the adopting country.

The final report of WP5 describes the best practices for road safety inspections. It is based on three internal reports regarding the state-of-the-art and a common understanding approach. The final deliverable as well as two public reports are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.6 Work package 6 'Best practice guidelines on Black Spot Management (BSM) and Safety Analyses of Road Networks (RSN)'

Black spot management (BSM) has a long tradition in traffic engineering in several countries in the European Union. In the last 5 to 10 years, more and more countries have supplemented this work with network safety management (NSM). However, the current approaches and quality of both BSM and NSM differ very much and the work can be characterised by a lack of standardised definitions and methods. Thus, the objective was to describe and develop state-of-the-art approaches and best practice guidelines for both BSM and NSM and to describe the necessary implementation steps.

State-of-the-art approaches are defined as the best currently available approaches from a theoretical point of view while best practice guidelines are the best approaches from a more practical point of view and can be used when the data and resources for developing, implementing and using a national method are limited.

No standard definition exists of either black spots or hazardous road sections. However, from a theoretical point of view black spots and hazardous road sections should be defined as any location that has a higher expected number of accidents than other similar locations as a result of local risk factors.

The authors of the final report recommend the identification of black spots by using accident prediction models rather than real accident data. In this respect black spots should be identified by reference to a clearly defined population of roadway elements as for example curves, bridges or four-leg junctions, while hazardous road sections should be identified by reference to 2-10 kilometres homogeneous road sections. This makes it possible to estimate the general expected number of accidents by use of an accident model.

The identification of hazardous locations should rely on a more or less advanced model based method, ideally speaking the empirical Bayes method. The argument for that is that model based methods are the best to make reliable identification of sites with local risk factors related to road design and traffic control, because systematic variation and partially random fluctuation are taken into consideration. To make the road division and develop the accident model it is necessary to have data about accidents, traffic volume and road design. These data have to be unambiguously located and interoperable with each other.
The state-of-the-art approach for accident analysis consists of two stages. The first stage is, by means of detailed examination of accidents, to suggest hypotheses regarding risk factors that may have contributed to the accidents. The second stage is to test the hypotheses. This can be done by a double blind comparison of each black or hazardous location and a safe location. According to the best practice guidelines, the analysis stage should as a minimum consist of a general accident analysis, a collision diagram, a road inspection and relevant traffic and road analyses.

Evaluation of the effects of the treatment should employ the empirical Bayes before-and-after design, because it controls for local changes in traffic volume, long term trends in accidents and regression-to-the-mean. When it is not possible, the evaluation should be made as a simpler before-after-study controlling for long-term trends in the number of accidents, local changes in traffic volume and regression-to-the-mean by use of correction factors.

The final report of WP6 describes both the state of the art and the best practices for black spot management. It is based on two internal reports and is available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.7 Work package 7 'Future Aspects'

This work package aims at presenting the current situation in the field of new technologies in the service of road safety, as well as their possible impact. Moreover, the role of standardisation is pointed out, presenting the current status worldwide, existing standards and relevant procedures.

More specifically, a review of relevant telematic applications is presented, giving their basic functions and application areas.

Furthermore, the impact of the use of new technologies is another issue that the final Deliverable deals with. Several relevant studies have been performed, mostly on a theoretical basis, since the introduction of most of these technologies in the market is up to now limited. A literature review of studies on the impact and deployment of new technologies is given there. Additionally, specific application scenarios have been selected and a rating from experts has been performed within the project, whose methodology and results are thoroughly presented.

The role of standardisation is becoming more and more crucial, especially in the area of telematic applications and ITS in general. Relevant initiatives are being undertaken by specialised organisations on national, regional and international level. The most indicative organisations, as well as their functions and activities, are presented in this Deliverable. The procedure of standardisation, as well as ITS related standardisation activities and existing standards are also subjects of the analysis.

The final deliverable bases on two internal reports. All reports are available from the project's website.
3.8 Work package 8 'Road User Behaviour Model'

The goal of work package 8 was to develop a model on road user’s behaviour. The final deliverable bases on two internal reports and describes the steps which were undertaken to develop and validate a driver behaviour model for rural roads.

It gives an overview on the theoretical background relevant for the model. Theories of human perception, information processing, decision making and action in general are included as well as psychological theories especially developed to explain driver behaviour.

The second part of deliverable D8 introduces the model which was developed based on the theoretical work summarized in the first chapter. This model describes, explains and predicts driver behaviour on rural roads.

The third part of deliverable D8 summarizes the steps which were conducted to validate this driver and driving behaviour model for rural roads and to test the possibility to integrate psychological parameters in a safety performance function (SPF). Depending on the different hypotheses derived from the model, the following data sources were used for this process:

- existing driving studies,
- additional data collected based on this existing data,
- own additional simulator experiments,
- own additional driving studies with an equipped vehicle.

Additionally, own laboratory experiments were conducted in a study of subjective road categorization. The results found after analysing the data collected in all these studies support the assumptions formulated in the models to a large extent. For example it was shown that high accident rate curves are systematically underestimated concerning demand and risk. Evidence was found that this underestimation results in inappropriate speed behaviour which could cause accidents.

Finally the integration of psychological variables in a safety performance function was tested.

The overall results of the different empirical research strategies revealed that most of the assumptions formulated in the hypotheses are supported by empirical data whilst other hypotheses have to be tested more extensively.

Another component in the model are expectations and mental models which are important both in the perception as well as in the interpretation of e.g. cues. The perceived road category is supposed to form a vital part in mental models which influence behaviour to a large extent.
To determine both this influence as well as gain further insight how these categories are built, an additional study on the subjective categorisation of rural roads has been conducted.

Further, work package 8 aimed at the integration of psychological parameters in a safety performance function (SPF). Despite the validation process of the model had been successfully carried out, it was not possible to assign numeric values to psychological parameters which would be the prerequisite for integration in a SPF. However, characteristic speed parameters could be used to approximate e.g. workload. The application of speed prediction models in the SPF thus allows at least a preliminary solution. By integrating the findings of the studies in future steps, the quality of these speed prediction models could be considerably enhanced. The integration of such psychological factors in speed prediction models for rural roads could ultimately result in a valid safety performance function.

The final report of WP8 as well as two internal reports on human factors and the road user behaviour model are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.9 Work package 9 'Best practice Safety Information Expert System'

The aim of work package 9 of this research project was to provide a freely accessible database for road authorities responsible for secondary roads, containing the Best Practice Safety Information Expert System. As a result SEROES has been developed.

SEROES the Secondary Roads Expert System is a web-based tool, freely accessible for everybody which comprises the possibility to be enlarged.

In that context information about road safety improvements from the EU-member states and a worldwide background has been collected, examined and synthesised.

Building on that framework and based on the Handbook of Road Safety Measures by Elvik and Vaa the Best Practice Safety Information Expert System SEROES has been developed and implemented.

The application is structured into various menus for users and an additional menu for administrators. SEROES is a tool with low accident and road data requirements. The user only needs the incident site, accident type and the cause of the accident as input, describing that way an existing road safety problem. Then the application offers several solutions, a cost-range and information about the effect for each of the provided measures. For a better understanding a user manual has been developed.

In a further step SEROES has been demonstrated together with the DST (Decision Support Safety Tool, see WP 11) in three countries: Turkey, Poland and the Netherlands. The demonstration of SEROES was integrated in the demonstration programme of the DST in WP12. It was carried out using a questionnaire.
The questionnaires were evaluated and a summary of the comments and suggestions of the users was elaborated.

Even if after the demonstration and several practical tests some possible improvements have been identified, the users’ general impression of SEROES was positive.

The final report of WP9 describes the expert system. It bases on two internal reports. All reports are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.10 Work package 10 'Formulation of Safety Performance Functions'

The goal of work package 10 was to develop analytic safety performance functions (SPF) which can be used for an assessment of road safety on new or existing road infrastructure.

Accidents are caused by numerous different factors: behaviour of driver, properties of infrastructure, surrounding conditions like traffic, weather etc. These various factors interact within a complex and complicated circle. Most existing accident prediction models as pointed out by work package 2 mainly consider the relation between infrastructure and accident parameters. Driving behaviour is excluded since there is no model available so far which considers the various aspects of driver behaviour. The approach of work package 10 takes into consideration both, infrastructure impacts and driver behaviour. The general thesis is that similar geometric properties cause similar driving behaviour and also the effects on road safety are expected to be similar.

Investigations of accident structure have pointed out that especially single accidents like driving accidents and accidents in longitudinal direction like passing accidents or rear end collisions have the largest portion on the total number of fatalities on secondary rural roads. For that reason, the development of the Safety Performance Function is based on the investigation and evaluation of selected accident types which are connected to the alignment of roads.

For the geometric parameters curve radius, curvature change rate and furthermore, for speed differences between consecutive elements correlation models have been developed which calculate estimated accident rates and accident cost rates. Additionally, the impacts of traffic volume and road width were also considered.

The derived results show that the investigation methodology is appropriate. Also the section definition and the pre-selection of accident types were approved since it lead to more accurate results and better correlation factors.

Based on correlation models between infrastructure parameters and accident occurrence a Safety Performance Function predicts statistically possible accident scenarios in order to detect potential lacks within a road network. This is quite
helpful if either no real accident data are available for investigations or effects of changes in a road network have to be estimated. In addition to other safety procedures like safety audit, safety inspection etc. the Safety Performance Function can reveal potentially hazardous road stretches. A comparison of the results with national or regional averages can show possible safety potentials. In this way SPF can be used for network safety analyses (NSM).

Within the frame of WP 10 a classification has been made on two different types of sections which consider the impact of driving behaviour: sections with similar alignment and almost constant speed level, and transitions with speed differences which are mainly small curves.

There is a large potential for integrating enhanced behaviour models which consider the various psychological aspects more accurately. Furthermore, a more detailed investigation of selected accident types and their impact on road safety should be done in order to improve accident prediction models and Safety Performance Functions. The results have shown that a differentiated consideration of accident types results in better correlation models.

A differentiated safety analysis concerning different road classes must also be integrated in a Safety Performance Function. Usually road classes are derived from the importance of a road within a network which directly decides about the design standard. For that reason, it is also recommended to further differentiate the investigation concerning road classes. Also, different accepted safety levels for certain road classes have to be defined since it is possible that a lower level of road safety may be accepted on lower classified roads than on high class roads.

Accident prediction models or Safety Performance Functions include correlation models which have been derived from analysis of real accident data. This means that most models are based on local accident data and often it is not possible to apply the model in other regions or countries. A proper opportunity is the adaptation by modification factors which consider local conditions. A clearly defined procedure should be developed which makes it possible to derive these modification factors in an easy way so that finally the models can be applied for other regions as well.

The final report of WP10 describes the Safety Performance Functions. Two internal reports provide information on the background of the functions. All three reports are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.11 Work package 11 'GIS-based Decision Support Safety Tool (DST)'

Within the frame of work package 11 a practical management tool has been developed to assist road managers and other decision makers on a regional level in finding the most appropriate way road safety intervention measures can be made. This practical management tool is called 'Decision Support Safety Tool
(DST)' and is based on the VIB that was developed in 2003 and successfully applied in 7 regions in the Netherlands.

The DST is based on the relation between road safety (the amount of deaths and hospital injured or accidents) and the amount of AADT (current situation and expected increase). The DST predicts the number of deaths and hospital injured in a forecast year based on:

- The actual road, traffic and accident situation in a basis year;
- The expected increase of the AADT;
- The risk reductions by implementing road safety measures.

Within this project, the DST has been tailor made for local circumstances in different EC-countries. The most important modifications to the DST are modifications with regard to the user-interface of the DST and the road safety measures (implementing own road safety measures by each country, the possibility to get more information about the measures, translation from English to another language, etc.) within the DST.

The information about road measures (costs and effects) is extracted from SEROES (Expert System; WP9 in the RiPCORD-IsEREST-project). The costs and effects can of course differ per country, but when there is no information available in a country, this information can be used as a starting point. The overview of measures in the DST should be checked before working with the DST in a country by a team of experts from this country in order to create a sufficient and appropriate list of (potential) measures. Implementing new measures or adapting specific costs or effects can be done easily. The only restriction is that there should be information available about the estimated costs and effects.

The DST, together with SEROES, has been demonstrated in three regions in Europe: a region each in Turkey, Poland and the Netherlands.

The final report of WP12 describes the DST. Two internal reports provide basic information on the background of the DST. All three reports are available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

3.12 Work package 12 'Demonstration'

The objective of Work package 12 is to investigate the usefulness and practicability of the GIS-based Decision Support Safety Tool and the Best Practice Safety Information Expert System which have been developed in work packages 9 and 11 in the RiPCORD-iSEREST Project.

The Best Practice Safety Information Expert System is based on an inventory of best practice information about road safety improvement gathered from all EU-member states and the world wide international background. It provides an estimate of the safety level of certain road infrastructure features or deficiencies. The system's validity and dependability have been checked in work package 12. For this purpose, questionnaires which were sent to the local experts in Poland and in Turkey were evaluated.
The Decision Support Safety Tool (DST) which has been further developed and improved in work package 11, helps road authorities to select appropriate safety intervention measures and develop different scenarios for road safety problems. The tool also helps to contemplate the road safety level and cost effectiveness to alternate the scenarios to improve road safety according to the policies of road authorities.

The DST has been applied to different problematic road sections with local traffic and road data in the Netherlands, in Poland and in Turkey considering different regions in Europe. These demonstrations were implemented and evaluated in work package 12. In these studies, cost and accident reduction estimates of different safety measures from SEROES have been taken from the DST data bank. Through these case study applications, the validity and efficiency of the tool in different regions have been questioned.

The DST has been demonstrated in the Netherlands in the Province of Fryslân. Within this province there are different regional cooperations between municipalities and other road managers in order to adjust their road policies to each other. The DST demonstration has referred to the region of North-east Fryslân.

Several road sections have been selected from the different parts of Turkey for the demonstration. Moreover, one long road section with different black spot concentrations was analysed in the Poland Demonstration.

The lack of data for the cost of the measures and ‘accident reduction effect’ restricted the demonstration study. Poland and Turkey case studies were continued with the measures having Western Europe cost and reduction effect data. Although this data limitation affected the dependability of the demonstration study results, the overall effectiveness of the tool was still positively tested in different regions.

The SEROES Expert System was used for finding suitable measures for the DST application. After the demonstrations and their evaluations, SEROES was improved based on the comments and explanations given by the experts.

The final report of WP12 describes the results of the demonstration of the tools in three different regions. It bases on two non-public progress reports. Only the final deliverable is available from the RiPCORD-iSEREST website (www.ripcord-iserest.com).

### 3.13 Work package 13 'Safety Handbook for Secondary Roads'

The objective of work package 13 was to produce a safety handbook as a contribution to standards and a practical tool for European local road managers. This handbook is addressed to local road managers without accident data availability or with low capability of managing such data in order to help users taking practical decisions about road safety interventions.

The handbook has been designed for giving a quick preliminary indication about a specific road safety problem, with technical and scientific background information given in the annexes or in specific references to other RiPCORD-iSEREST
tools and deliverables. It contains information about the background of road safety, geometric parameters, road elements, human factors and it will be particularly valuable in European regions less advanced in the field of road safety management.

3.14 Work package 14 'Dissemination'

The main objective of WP 14 was to give an overview of the (most important) results of all work packages and particularly to disseminate the results, the recommendations and the implementation aspects of the whole RiPCORD-iSEREST project. Beside this another main objective is to ensure that the project suites the practitioners' needs and that the project findings are well re-cognised.

The dissemination activities included the preparation of a public web-site [www.ripcord-iserest.com](http://www.ripcord-iserest.com) from which all public documents can be freely downloaded, the organisation of two conferences and a practitioners' group consisting of 36 experts from 17 European countries.

Moreover three newsletters and a brochure have been published as well as several lectures have been held to disseminate the project results.

Deliverable D14 provides an overview on the dissemination activities and can be downloaded from the project's website.