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Road and Tunnel Safety Management: Establishment of a Common Enhanced Approach to Road Infrastructure and Tunnel Safety Management

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Abstract

The objective of the ECORoads project is to overcome where appropriate the barrier established by a formal interpretation of the two Directives 2008/96/EC (on road infrastructure safety management) and 2004/54/EC (on tunnels), that in practice do not foresee the same Road Safety Audits/Inspections (RSA/RSI) to be performed on open roads and in tunnels. To overcome this legal barrier, the project examined a common-coordinated enhanced approach by applying some of the concepts (RSA/RSI) of the Directive 2008/96/EC to transition areas between tunnels and open roads, without jeopardising (but rather complementing) the usual tunnel safety management operations. This paper presents the results of the project which includes the recommendations and guidelines for the application of the RSA and RSI concepts within the tunnel safety operations.

Keywords: road and tunnel safety management, road inspection, road audits

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Nomenclature

RSA	Road Safety Audits
RSI	Road Safety Inspections
EuroTAP	European Tunnel Assessment Programme
TEN-T	Trans-European Transport Network
EESC	European Social and Economic Committee

1. Introduction

The objective of the ECORoads project is to overcome where appropriate the barrier (Fig. 1) established by a formal interpretation of the two Directives 2008/96/EC (on road infrastructure safety management) and 2004/54/EC (on tunnels), that in practice do not foresee the same Road Safety Audits/Inspections (RSA/RSI) to be performed on open roads and in tunnels. The main problem is that, while from the user (driver) point of view a road is a unique linear infrastructure generally in open terrain and sometimes in closed environment (tunnels), the strict application of the two Directives leads to a non-uniform approach to the infrastructure safety management outside and inside tunnels.

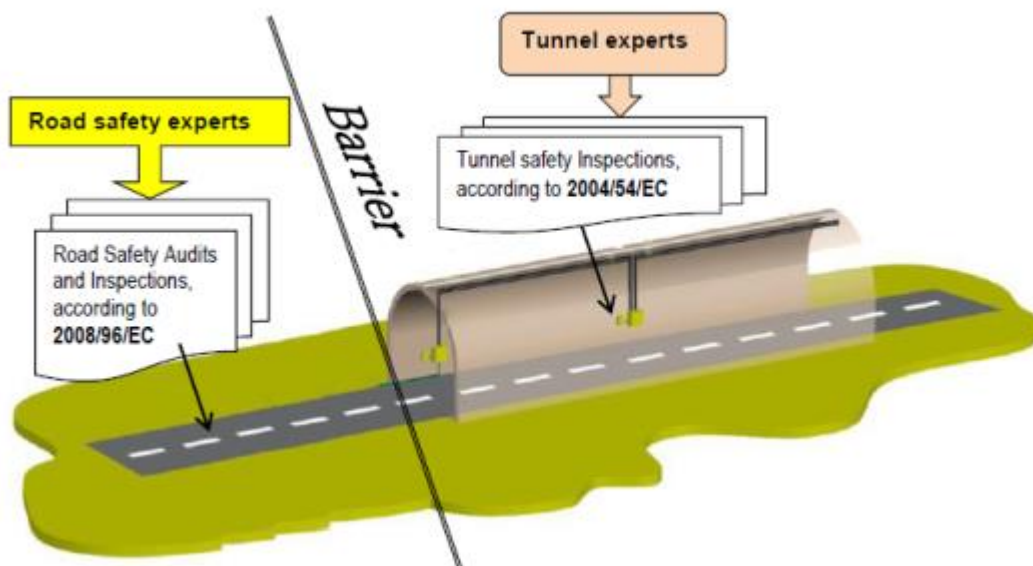


Fig. 1 The “barrier” between the two EU Directives

This project is the follow-up of the initiative related to the European Road Safety Directives and the two workshops held at the European Social and Economic Committee (EESC) by a group of international stakeholders in February and May 2013: a debate that was initiated as a result of the coach crash in Switzerland that caused more than 28 fatalities, including 22 children.

The collision occurred in 2012 with the end wall of an emergency parking facility in the Sierre tunnel, Switzerland, which was opened in 1999 and was rated as “good” in a 2005 European Tunnel Assessment Programme (EuroTAP) test. The end wall was placed at 90 degrees with respect to the direction of the adjacent traffic flow, without any adequate protection from collision.



Fig 2 Left: the lay-by in Sierre Tunnel. (source – www.ecoroads.eu). Right: similar situation (source: Hasani A., Albanian Roads Authority)

This feature of tunnel design is typical of many European tunnels, as shown in Fig. 2 (90° walls without any protection), where operations such as RSA or RSI according to the prescriptions of the Directive 2008/96/EC, could be beneficial for risk prevention. Indeed, this Directive does not apply to road tunnels covered by Directive 2004/54/EC (Art.1, point 4 of the Directive 2008/96/CE).

On the other hand, Directive (2004/54/EC) does not deal directly with RSA or RSI inside the tunnels. There is only a general statement about taking "all aspects of the system composed of the infrastructure, operation, users and vehicles" into account in Annex 1. Different interpretation and application by Member States may further amplify the gap between the two Directives.

The aim of the ECORoads project is to ensure that road users can move on European roads where uniform safety measures have been planned and implemented, avoiding different approaches stemming from formal discrepancies in the interpretation of EU Directives.

The project establishes a common enhanced approach to road infrastructure and tunnel safety management by:

- Organising workshops with stakeholders (e.g. tunnels and road managers), which includes the analysis/review of national practices regarding RSI/RSA, starting from the results of the two studies launched by DG MOVE to assess the impact of the two Directives.
- Exchange of best practices and experiences between European tunnel experts and road safety professionals.
- Pilot joint safety operations on some European road sections having both open roads and tunnels.
- Recommendations and guidelines for the application of the RSA and RSI concepts within the tunnel safety operations.

2. Methodology

The overall approach of the ECORoads is based on a previous project Pilot4Safety (Pilot4Safety "Pilot project for common EU Curriculum for Road Safety experts: training and application on Secondary Roads (<http://pilot4safety.fehrl.org>)) and is divided into several phases (Fig. 3):

- Organising workshops with stakeholders (e.g. tunnels and road managers), which includes the analysis/review of national practices regarding RSI/RSA. Such overviews have been conducted on the basis of the results of two previous studies on the effectiveness of the Directive 2008/96/EC (Transport and

Mobility Leuven, 2014) and on the implementation and effects of Directive 2004/54/EC (ICL International, 2015), plus direct contact with several infrastructure managers.

- Exchange of best practices and experiences between European tunnel experts and road safety professionals.
- Pilot joint safety operations on some European road sections having both open roads and tunnels.
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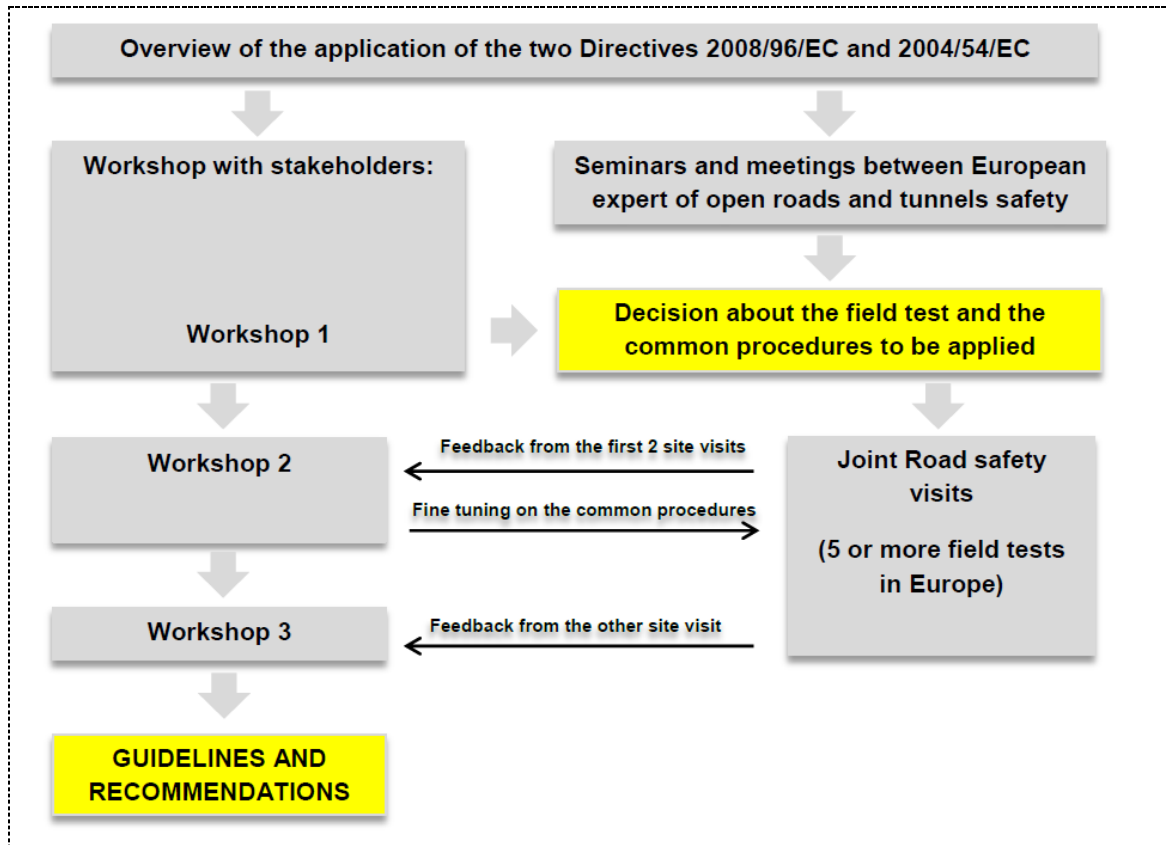


Fig. 3. ECORoads Methodology

2.1. Joint Audit/Inspection procedures

During the Seminar for exchange of best practices on RSA/ RSI on open roads and tunnels, and during dedicated meetings between the ECORoads partners, held between November 2015 and January 2016, a preliminary procedure has been agreed, based on the following considerations.

The Directive 2008/96/EC applies to road sections of the Trans-European Transport Network, whether they are at design stage, under construction or in operation. Its provisions may also be applied to national road transport infrastructure, not being part of the TEN-T but constructed - entirely or partly - using Community financial assistance.

Based on a large literature review, the Pilot4Safety Project Handbook (Polidori et al. (2012)) concluded on the following consolidated definitions of RSA and RSI:

- Road Safety Audit describes a systematic and independent examination of a project designed to highlight potential safety issues at the earliest possible stage of planning and construction, to reduce or eliminate these problems and limit the risk for different types of road users.
- Road Safety Inspection is a preventive safety management tool implemented by road authorities/ operators as part of a global Road Safety Management. A RSI is a systematic field survey organised sufficiently frequently on all existing roads or sections of a road to secure adequate safety levels. It is carried out by

trained road safety experts to identify hazardous conditions and deficiencies that may lead to serious accidents. RSI results in a formal report on detected road hazards and safety issues.

The Directive on Tunnels (2004/54/EC) makes reference to periodic inspections carried out by the tunnel's Inspection Entity at maximum intervals of 6 years for any given tunnel; it requires a Safety Documentation (Annex II), which describes the processes for approval of the design, for opening of a tunnel, for modifications in the physical and operational characteristics of a tunnel and for performing periodic exercises for tunnel staff and emergency services, and includes the content and results of a Risk Analysis.

Regarding the typical processes of the distinct Road/ Tunnel Safety procedures described above, both RSA/ RSI and tunnel safety inspection (TSI) contain the assignment from the Client/ Assignor (responsible authority/ body/ unit) and an independent approach by the assignee (Auditor/ Inspection Team) to perform the appropriate activities and report back, with interaction between two sides before and after the duration of these activities and reporting. Therefore, compared to RSA/ RSI, other procedures are foreseen for safety assessment of tunnels that are subjected to the Tunnel Directive.

To this end, the ECORoads objective was to experiment on the incorporation of the tunnels' safety procedures in an integrated approach for joint safety operations on both tunnels and open roads, with focus on road safety. The ECORoads approach is purely "operational" and finalized to an integrated practical approach that is going to be substantiated in practical guidelines and recommendations.

On the basis of the feedback from the 1st project Workshop held in September 2015 and the Seminar for exchange of best practices held in November 2015, and considering the experimental approach of the project, the following categories of involvement in the field tests process were foreseen (Adesiyun et al. (2017)):

- Infrastructure (Road/ Tunnel) Manager(s): the administration/ authority/ manager(s) of the road/ tunnel infrastructure of each of the ECORoads field tests.
- Host organisation: The organisation/ authority that organises and facilitates the field test.
- Audit/ Inspection Group: the mixed international team of (road/ tunnel) experts and other stakeholders that will take part in a field test. It consists of the Core Audit/ Inspection Team, the "External" observers, the Facilitator, internal observer and other experts.
- Core Audit/ Inspection Team: the mixed international team of experts that are assigned/ authorised to jointly and independently perform an audit/ inspection visit.
- "External" Observers: stakeholders with different competences, representing different authorities accompanying the Core Audit/ Inspection Team in a field test.
- Facilitators: local/national experts ensuring organisation, communication and cooperation between the infrastructure manager(s) and the project.
- ECORoads "Internal" Observer: A member of the ECORoads consortium.
- Other "External Experts" and Stakeholders: other local and national interested parties (incl. road user groups) providing complementary information to each Core Audit/ Inspection Team.

The roles and responsibilities of the actors involved in the field tests and their interactions are schematically presented in Fig. 4.

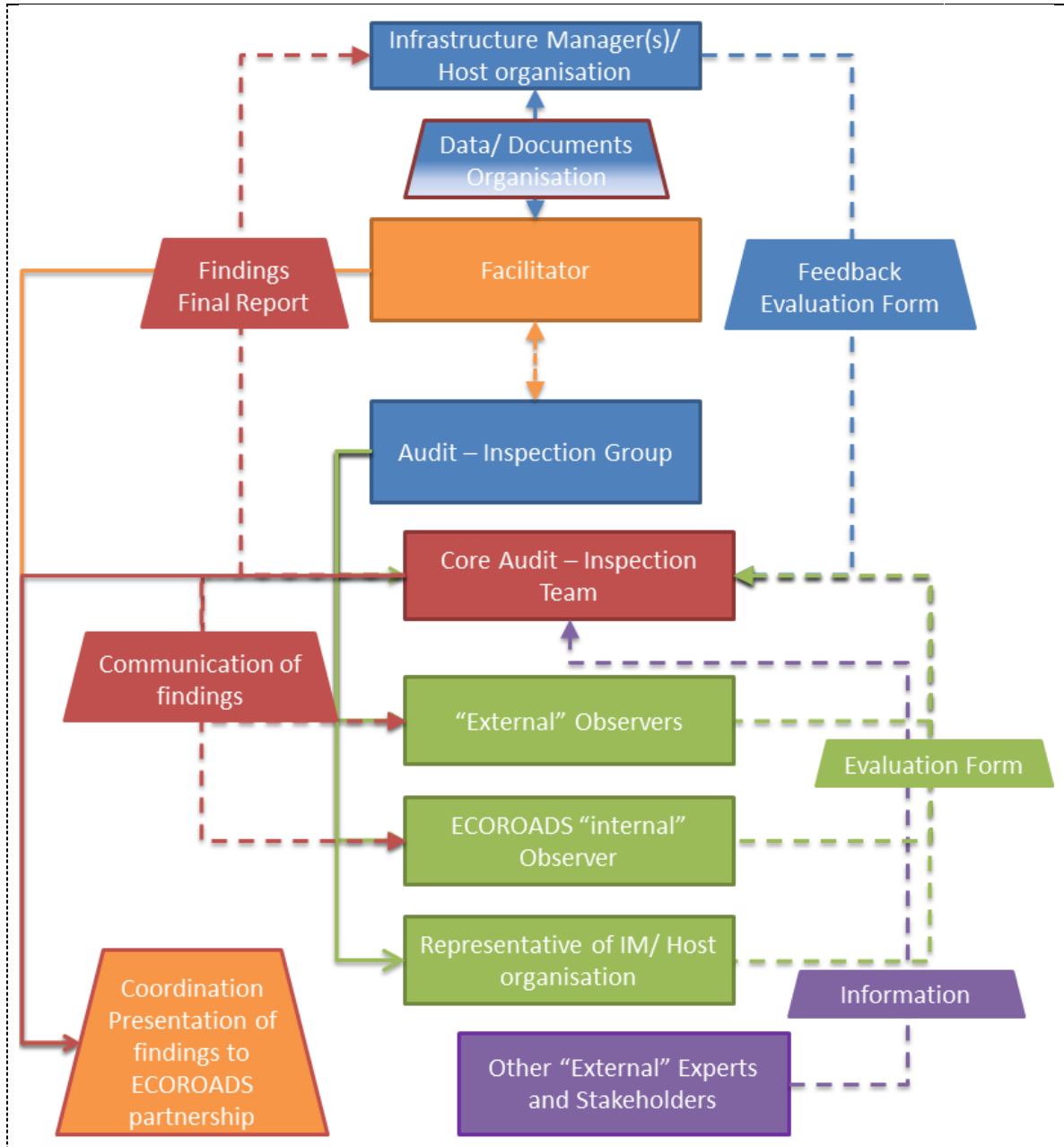


Fig. 4 Roles and responsibilities of parties involved in ECORoads field tests

Joint safety operations on European road sections with both open roads and tunnels, particularly focused in the transition areas were conducted by international teams composed of road safety and tunnel safety experts. The primary scope was to show how the Road Safety Inspection procedures can be transferred to tunnels; then an “inspection report” written by both tunnel and road safety experts was submitted to the infrastructure manager.

The operations were conducted on 5 test sites (Table 1) selected from a list of 15 possible locations. Tunnel operations were conducted by a “core team” of tunnel experts and road safety experts accompanied by observers and vice-versa. In this way, an actual cross-fertilisation between the two groups of experts led to an enhanced approach to the infrastructure safety management. A group of “observers” also participated at the visits. In total, experts from 11 countries were involved in the joint safety operations. Details are shown in table 1.

Table 1. Overview of the 5 test sites.

TEST SITE, Country	Dates of the joint visits	N. of Experts (core team)	N. of Observers	N. of other Experts	Tunnel type and length	Length of open road inspected
KENNEDY TUNNEL – Belgium	07-08 March 2016	3	3	6	2 tubes, 690 m each	1200 m
KRRABE TUNNEL- Albania	05-06 April 2016	4	4	5	2 tubes, 2230 m and 2500m	1500 m
TUNNEL RENNSTEIG Germany	17-18 August 2016	3	3	4	2 tubes, 7916 m each	400 m
TUNNEL STRAZEVICA Serbia	27-28 Sept. 2016	3	1	12	Single tube 745 m	650 m
TUNNEL DEMIR KAPIJA Former Yugoslav Republic of Macedonia	18-19 October 2016	4	0	9	Single tube 554 m	400 m

3. Conclusions from the ECORoads approach

3.1. Joint safety operations in tunnels and open roads are possible

There are no technical nor operational barriers to the joint safety operations in tunnel and open roads. ECORoads has analysed that, when managing the real traffic flows in the real infrastructure, there is a need for coordinated actions. This particularly applies to the transition areas where the two different infrastructures (“open roads” and “tunnels”) meet, which leads to the need to develop a harmonised safe traffic management regarding concepts of RSA and RSI.

During the operations in the 5 test sites, there was a good level of involvement of infrastructure managers (of tunnels and open roads) and the core group. A multi task procedure was adopted to allow an experimental deployment of a multi-disciplinary and multi-functional team of international experts. Since the common procedures adopted by the project have been validated through the success of the joint safety operations, the simplified scheme in Fig. 5 below can be successfully adopted by each infrastructure manager by using the ECORoads procedure.



Fig. 5 Simplified scheme of the ECORoads approach

In practice, the “Facilitator” figure is covered by the person belonging to the infrastructure manager, who is in charge of organising the operations. Observers are no longer needed, nor are the related flow of feedback and evaluation forms.

3.2. Joint safety operation in tunnels and open roads particularly focused on transition areas are useful

ECORoads collected 42 feedback forms from the expert group, as described above, since due to the rotation of the figures involved, all the members of the core groups were observers in at least one joint safety operation. There was widespread consensus on the following added value of the joint safety operations:

- Working in a mixed team (safety/tunnel experts), mixture of experiences from different countries.
- Common/coordinated approach for open roads - transition area - tunnel in one project that guarantees a harmonised safety approach in the traffic management, respecting the different technical characteristics in each area.
- Exchange of knowledge and best practices.
- Opportunity to visit and see the tunnel from the inside and see traffic and driver behaviour both inside and outside the tunnel (“feel the traffic on my own”).
- Opportunity to examine the tunnel without traffic.
- Close collaboration between road safety experts and tunnel safety experts regarding the common view of the transition area as a whole.
- Mainly the view of road safety experts on the part of the road in the tunnel with its specific characteristics can be very conducive to evaluate the total safety of the road in a closed environment (tunnel).

3.3. An international team does not imply more difficulties but adds value

On the basis of the feedback collected from the ECORoads observers, having at least one road or tunnel safety expert in the team does not cause difficulties and adds value to the joint operations, given the different approach and point of view that person can bring to the team.

It is obviously necessary that at least the team leader and the foreign expert must speak the same language in order to understand the explanations and properly interact with the team.

When the infrastructure manager plans to add a foreign expert to the team, his/her acceptance should be negotiated with the team leader before formalising the appointments.

4. Recommendations

The following recommendations are addressed to decision makers (regional, national and European), aiming at the improvement and optimisation of the current normative framework.

The following key points and issues are based on the evaluation of the joint safety operations and the exchange of best practices and comments received during and after the workshops.

- According to the project results, certain concepts of Directive 2008/96/EC (on road infrastructure safety management) can be applied to the scope of Directive 2004/54/EC (on tunnels), in close cooperation with the managing departments in the two areas.
- Road sections, including tunnel sections, should be inspected/audited by both tunnel and road safety experts.
- Transition areas between tunnels and open roads are of particular interest in terms of their impact on road safety.
- An innovative update of the new safety standards following the technical developments is welcome. A harmonised approach to fire detection, fire-fighting and communication coverage in tunnels should be addressed.
- Member States, as supervision authorities, should ensure the mutual recognition of Road Safety Auditors and Road Safety Inspectors certified by other Member States.
- A coordinated approach to the road safety management of both tunnels and the transition areas is recommended. This will surely facilitate better future integration of road and tunnel infrastructure, also taking into account the costs and benefits of deploying intelligent transport systems and services.
- Since the majority of road fatalities in the EU occur outside the TEN-T, an extension of the scope beyond the TEN-T to other roads should be considered.
- The exchange of experts and best practices should be enhanced and facilitated.

ECORoads analysed the deployment of the two Directives and experimented on the field the possibility of joint safety operations. The project did not analyse any specific scenario regarding the future of the two Directives, but specific technical considerations were identified from the findings: the analyses carried out in the project clearly show that there are common elements regarding the safety management in the two areas (open roads and tunnels), which could be tackled in a harmonised way through a coordinated communication by the concerned open road and tunnel experts.

Assuming that the two Directives deal with different issues in different environments, such coordinated actions can be foreseen by adding/inserting harmonised legal texts into the bodies of the two Directives; any possible insertion into one Directive should take into adequate consideration the consequences to the other Directive and vice-versa.

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