

Effective and Coordinated Road Infrastructure Safety Operations



The ECORoads approach

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Final conference
Brussels, May 10, 2017

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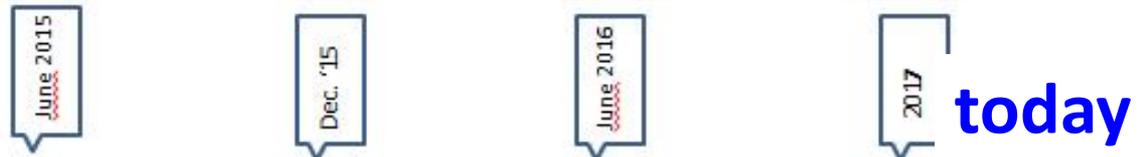
1. Joint Road Safety Operations: How are they defined? (WP 5)
2. Definition of Common Procedures (**CP**)
 - Object of the joint operations
 - Organization and planning
 - Roles and responsibilities
 - Tools, methods and outputs
3. Final report on the Field Tests
 - Comparison of followed procedures with the Common Procedures (feedback from Internal Observer)
 - Feedback from participants
 - Feedback from Infrastructure Managers (**IMs**)

1. WP5 - Joint Road Safety Operations: How are they defined?

“Joint Road Safety Operations” for the scope of ECORoads project:

Joint visits, made by an international team of road safety and tunnel safety experts (with a significant experience in the specific field(s)) with the aim to simulate RSA and RSI procedures, inside selected tunnels and transition areas, in a uniform way and on the basis of commonly agreed procedures (Common Procedures), as defined by the project.

Timeline



Month n°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
WP1 Project Management		D1.1																							
Task 1.1 Administrative and financial Management	X	X									X	X	X										X	X	
Task 1.2 Reporting to the EC												X	X												X
Task 1.3 General Coordination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WP2- Overview of the application of the 2 Directives			D2.1	D2.2																					
Task 2.1 Summary of the previous studies	X	X																							
Task 2.2 Analysis of the user's needs	X	X																							
Task 2.3 Document for the workshops		X	X	X																					
WP3 Workshop with stakeholders					D3.1								D3.2								D3.3				
Task 3.1 Workshop 1			X	W1	X																				
Task 3.2 Workshop 2											X	W2	X												
Task 3.3 Workshop 3																		X	W3	X					
WP4 Exchange of best practices					D4.1																				
Task 4.1 Road safety practices in tunnels					X	X																			
Task 4.2 Road safety practices in open roads					X	X																			
Task 4.3 Common discussion and proposals					X	M1										X	X	X							
WP5 Joint road safety operations							D5.1		D5.2												D5.3				
Task 5.1 Definition of the common procedures							X	X																	
Task 5.2 Field tests									X	X	X		M2	X	X	X	X	X	X	X					
Task 5.3 Reporting and feedbacks										X	X						X	X	X	X					
WP6 Guidelines and recommendations													D6.1									D6.3			
Task 6.1 Preliminary version of the guidelines											X	X	X												
Task 6.2 insertion of comments and fine tuning															X	X	X		M3	X	X				
WP7 Dissemination		D7.1;D7.2			D7.3							D7.3a									D7.3b				
Task 7.1 Dissemination and exploit./implement. Plan																									
Task 7.2 Project web site and other dissem. material		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Task 7.3 Final Conference																						X	X	X	F
LEGENDA: P= Project meetings; M= Milestones	P1					P2						P3							P4						P5
Dx.y = Deliverables W = Workshop F = Final Conference	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Task 5.1 Definition of the Common Procedures

Deliverable 5.1: Common procedures, with the indication of the safety procedures (SEETO) *public report*

Effective and Coordinated ROAD infrastructure Safety operations 

H2020 Coordination and Support Action
 Topic: MG-8.1b-2014 (Smarter design, construction and maintenance)
 Grant Agreement number: 652821
 Start date: 01 June 2015
 Duration: 24 months

Effective and Coordinated Roads Infrastructure Safety Operations
 ECORoads

Deliverable D5.1

Definition of Common Procedures
 For the performance of Joint Road Safety Operations
 Final Report/ V0.3

Main Editor(s)	M. Miltiadou, SEETO, Serbia L. Cela, SEETO, Serbia M. Gjorgjeviski, SEETO, Serbia
Due Date	01 February 2016
Delivery Date	28 January 2016
Work Package	WPS – Joint Road Safety Operations
Dissemination level	Public

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Table of contents:

1. Introduction
2. Objective, methodology and activities undertaken
3. Definitions
4. Types of involvement in ECORoads field tests – roles & responsibilities
5. Organisational details
6. Technical details – Tools and outputs
7. Conclusions

Task 5.2 Field Tests

From long list (15) to short list (5) of test sites

Workshop (1/3)

30th September 2015

1st set of field tests:

- Kennedy Tunnel, Antwerp, Belgium: 7 & 8th of March 2016
 - Krrabe Tunnel, Tirana, Albania: 5 & 6th of April 2016
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Workshop (2/3)

2nd June 2016

2nd set of field tests:

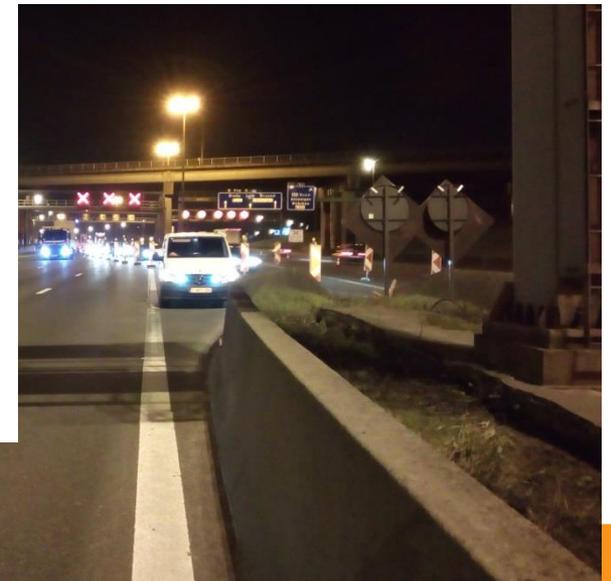
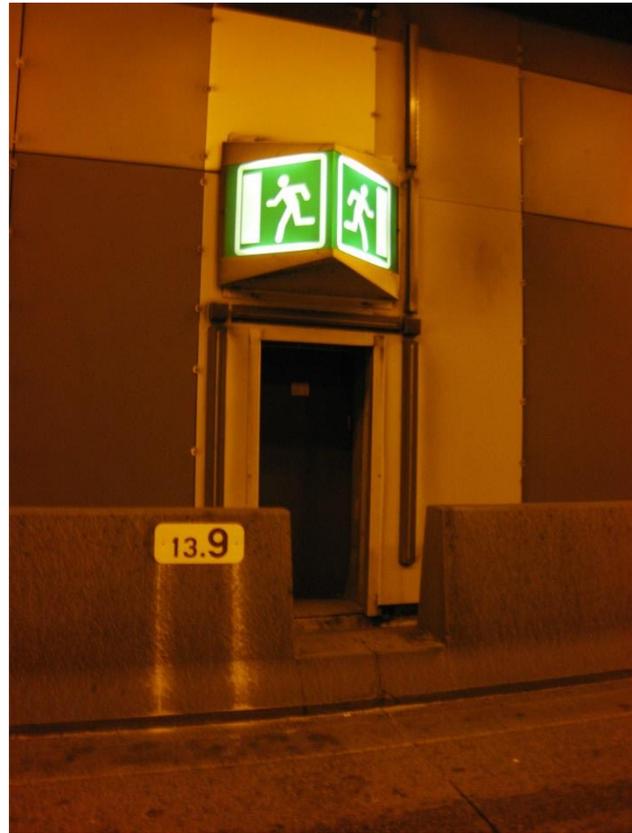
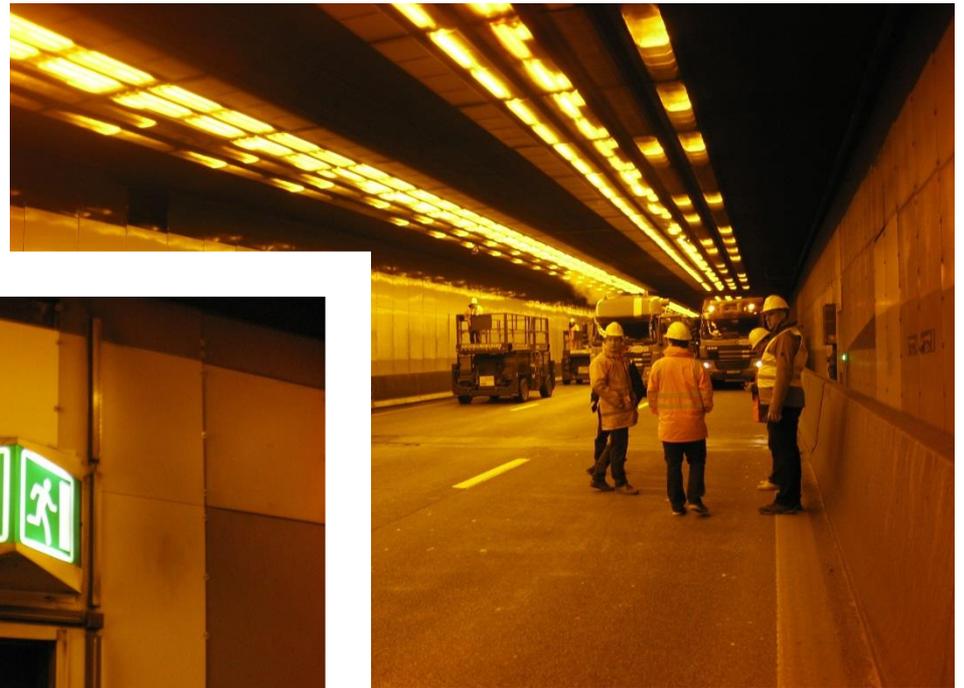
- BAB A71/Rennsteig Tunnel, Thüringen, Germany: 17 & 18th of August 2016
 - Belgrade bypass Strazevica Tunnel, Serbia: 27 & 28th of September 2016
 - Demir Kapija Tunnel, Corridor X, Macedonia: 18 & 19th of October 2016
-

Workshop (3/3)

21th February 2017









Task 5.3 Reporting & feedbacks

Several reports, for each test site:

- Inspection report (= RSI report)
- Response from the Road/Tunnel Manager

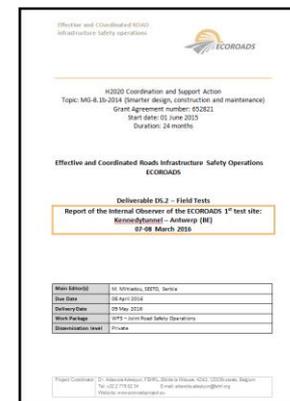


concerning possible road safety deficiencies

- Internal Observer Report
- Summarized feedback from participants



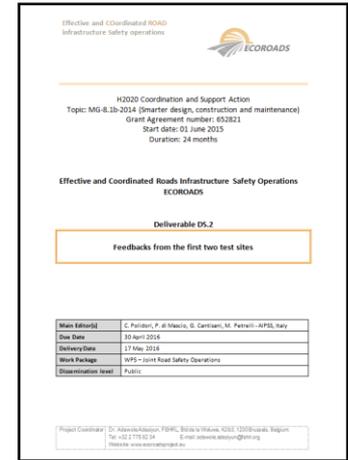
concerning the Common Procedures (feedback)



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Task 5.3 Reporting & feedback

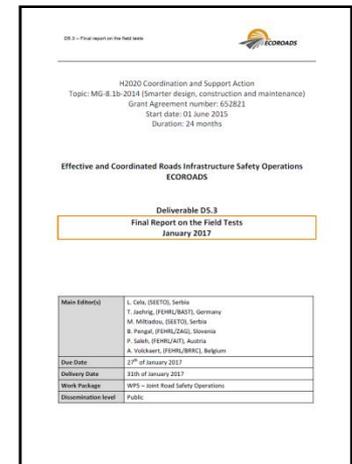
Deliverable 5.2: Feedbacks from first tests (AIPSS)
public report



Deliverable 5.3: Final report on the Field Tests (FEHRL)
public report

Table of Contents:

- Introduction
- For each test site:
 - Internal observer report
 - Summarized feedback
- Conclusions
- Annex:
 - compilation of all evaluation forms
 - blank evaluation form



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2. Definition of Common Procedures (Task 5.1)

Contents:

- Object of the joint operations
- Organization and planning
- Roles and responsibilities
- Tools, methods and outputs (reporting)

Common Procedures for the performance of Joint Road Safety Operations

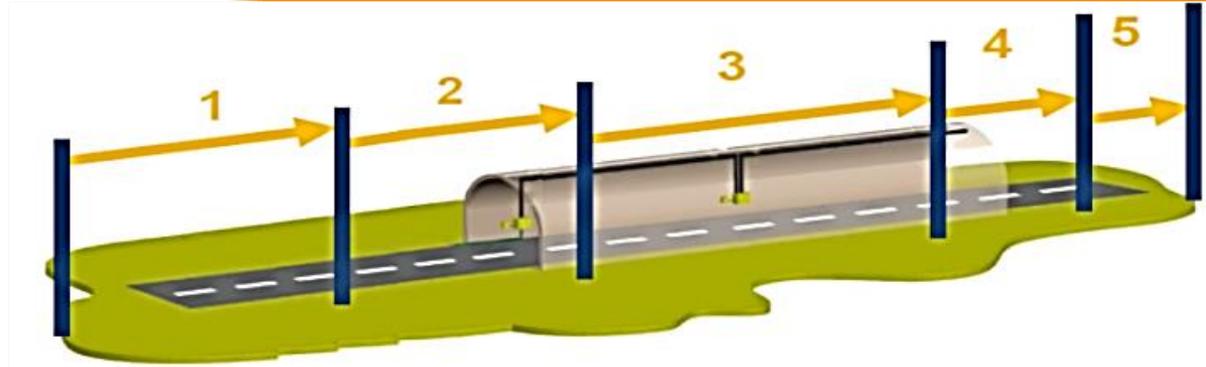
Procedures developed for joint RSA/ RSI operations by Road and Tunnel experts (mixed teams) at 5 different locations (2 in EU and 3 in SEETO area).

Concerned the **organization, performance, reporting and evaluation procedure**, taking into account the need for defining road/tunnel safety parameters to be assessed, roles and responsibilities of visiting teams, monitoring, etc.

Developed on the basis of relevant research and experience and the outcomes of:

- the 1st Workshop with stakeholders (September 2015)
- a Seminar for exchange of best practices (November 2015)
- 3 internal (WP5) web conferences (November 2015 and January 2016)

Object of the joint operations

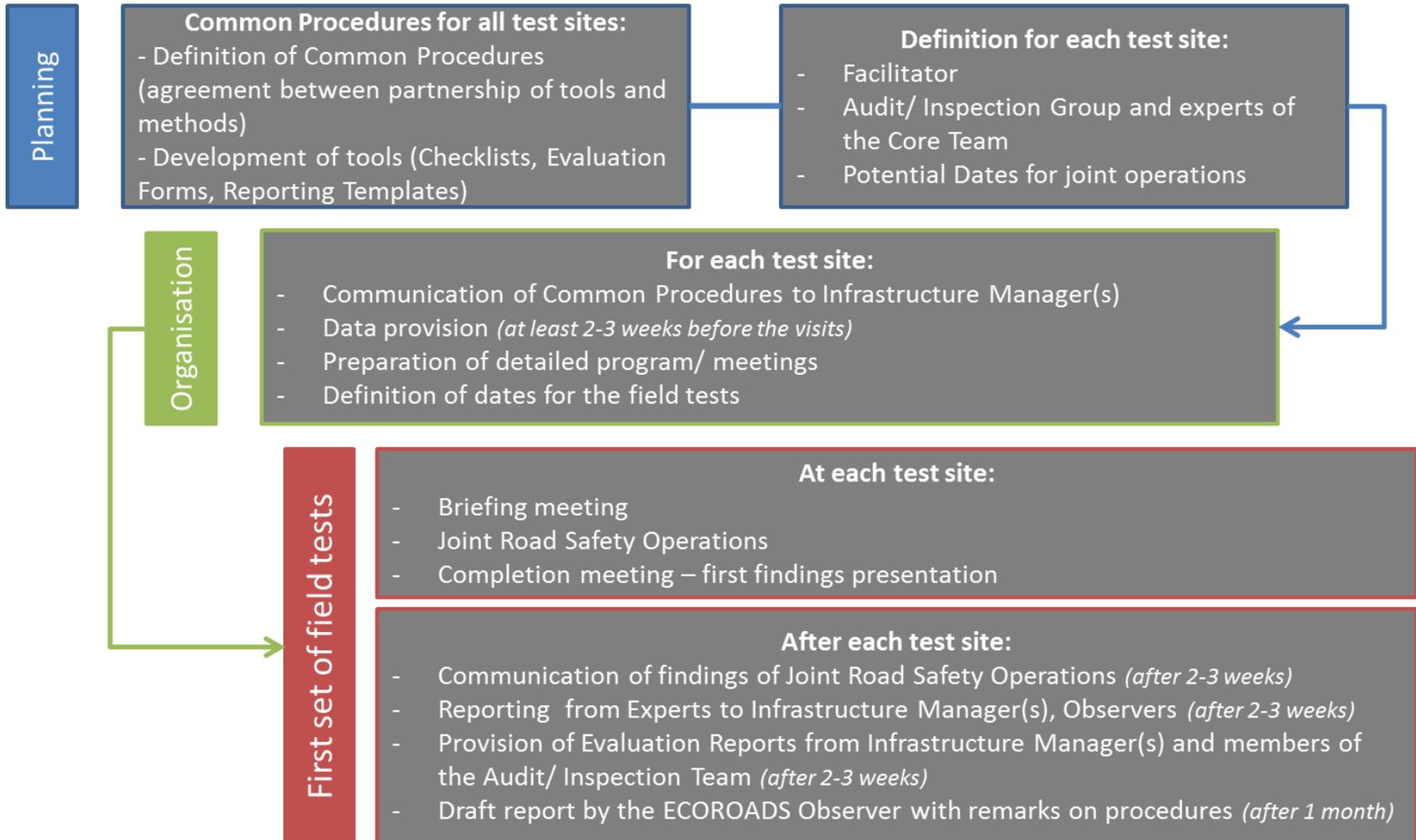


The principles for the **segmentation of the infrastructure subjected to the joint road safety operations** had been discussed in detail between the partnership at early stage of the project and with the stakeholders that participated at the first project Workshop.

The joint operations should be performed (on both sides and bi-directionally) at:

- a) the adjacent (to the tunnel) open roads (length depending on site particularities e.g. the influence of the tunnel);
- b) the tunnel transition areas (length calculated as the sum of the distance covered in 10 seconds by a vehicle travelling at the speed limit before the tunnel portal and the stopping distance after the tunnel portal, for a vehicle travelling at speed limit, if not identical with design speed); and
- c) the tunnel interior.

Planning and Organization of the Field Tests – Flowchart



Planning and Organization of the Field Tests – Programme

At each field test a 2-days programme was formulated, comprising:

- a **Briefing Meeting** to present to the participants the scope and procedures of ECORoads field tests and for the experts to receive details of the project under RSA/RSI and clarifications on issues that emerged from the available data and information and to collect information and opinions from external experts and other stakeholders.
- **Site visit during daylight/ under traffic.**
- **Technical visit at tunnel control centre.**
- **Site visit during night/ during infrastructure closure.**
- a **Working Meeting** for the Core Team to prepare their preliminary report and participants to prepare their feedbacks.
- a **Completion Meeting** for the presentation of the experts' findings and for the coordination of further activities (reporting, feedbacks and deadlines)

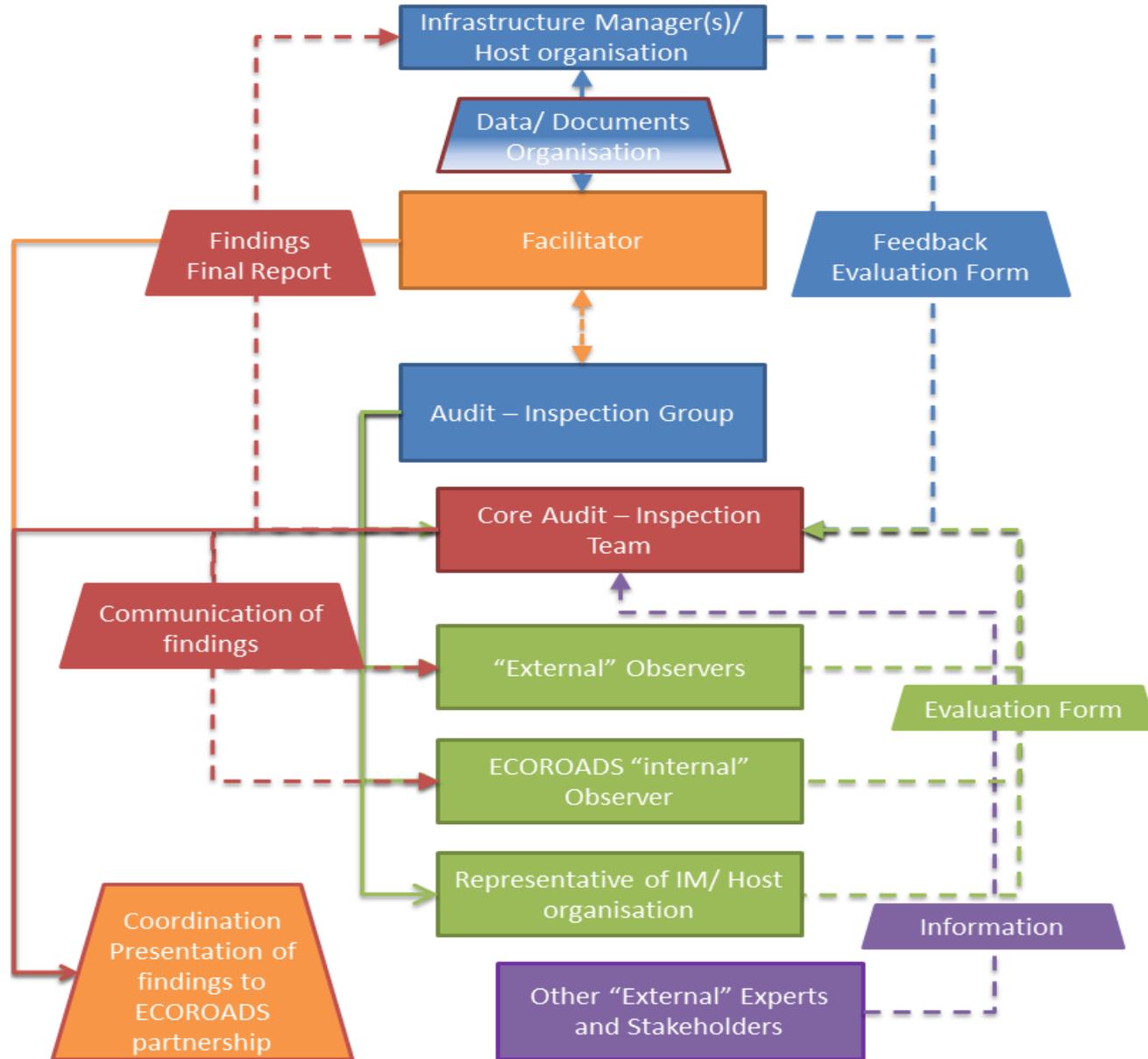
Roles & Responsibilities of the RSA/RSI Group members

RSA/RSI Group: Mixed international team of (road/ tunnel) experts and other stakeholders that take part in a field test.

The Group for each Field Test consisted of:

- the **Core (Audit/ Inspection) Team**: formed by at least three, and preferably four (2 road + 2 tunnel), experts, with one of the road safety experts as Team Coordinator.
- the **“External” observers**: stakeholders with different competences, representing different authorities - provide information to the Core Team.
- the **Facilitator**: local/ national expert and member of the ECORoads consortium - direct link and cooperation with the IMs for organizational and operational purposes, before and after the site visits.
- the **ECORoads “Internal” Observer**: member of the ECORoads consortium - monitors the joint RS operation and report back to the project.
- **Other External Experts and Stakeholders**: experts/ stakeholders from local and national interested parties (provided this was allowed in order to maintain a specific number of team members on site).

Roles & Responsibilities



Required data and documents

Mobilization of many experts → need to ensure time and costs savings → Need to dedicate more time in preparatory work and exploit available data and documents before the field tests:

- Designs “as built” (longitudinal and cross sections);
- Description of deviations from official standards and from detailed design + Documentation;
- Data on traffic volumes and traffic composition for the last 5 years;
- Data on accidents and analysis (type, severity, cause, involved type of vehicle, etc.) for the last 5 years;
- Maintenance plans;
- Designs/ descriptions of most recent intervention(s);
- Traffic signal systems and operational manuals of traffic guidance systems (Variable Message Signs - VMS);
- Traffic signs and markings plans;
- Schemes, calculations/ data on lighting conditions; and
- Safety documentation for tunnels, where applicable.

Safety and exploitation of modern technology

Appropriate measures had to be taken, in cooperation with the IM and the Traffic Police, given the more radical measures required for carrying out inspections on high speed roads and inside tunnels.

The use of official cars for the transfer to the site and during the inspection was considered most suitable, having appropriate warning signage.

Members of the visiting Group were obligated to wear helmets and phosphorescent vests and to take care not to burden the traffic/other road users.

For ensuring the least need of exposure of the visiting Group to traffic during inspections, pictures and video recordings would be used for preparation and reporting purposes.

The usage of mapping and routing software, satellite images and project digital layouts was important for preparatory purposes, and especially for reporting.

Checklists

A mean that would ensure a homogeneous approach and assessment of road safety.

Especially concerning tunnels and transition areas: two dedicated checklists were composed, comprising aspects that influence road safety at these segments.

Developed taking into account:

- the relevant EU Directives' criteria,
- elements for tunnel safety assessment included in RSA/RSI checklists in various countries,
- relevant national guidelines that include such provisions for RSA/RSI in tunnels and
- the PIARC work on human factors and road tunnel safety regarding users.

Feedback and reporting

The reporting, feedback and monitoring process comprised:

- a report with the identified road safety deficiencies (**Report of the Core Team**), delivered to the Infrastructure Managers and the other members of the visiting Group, with description of the proposed measures and experts' recommendations/ advice for solutions to alleviate problems and to reduce risks and accidents' numbers or severity in the short-, medium and long-term;
- **feedbacks from all members of the visiting Group**, on specific templates designed per participant's role;
- a **Report of the "Internal" Observer** on the conformity of the procedures followed with the Common Procedures;
- the **feedback from the Infrastructure Manager** on the findings of the experts' Report; and
- the **Final Report**, taking into account the response of the Infrastructure Manager.

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 - Feedback from Infrastructure Managers

3. Final Report on the Field Tests (D 5.3)

Contents:

- Comparison of followed procedures with Common Procedures (feedback from Internal Observer)
- Feedback from participants
- Feedback from Infrastructure Managers (IM)

Final Report Table of Contents:

- Introduction
- Test site I: Kennedy Tunnel
- Test site II: Krrabe Tunnel
- Test site III: Rennsteigtunnel
- Test site IV: Strazevica Tunnel
- Test site V: Demir Kapija Tunnel
- Conclusions

Antwerp, Belgium
 Tirana, Albania
 Thüringen, Germany
 Belgrade, Serbia
 Former Yugoslav Republic
 of Macedonia

DS.3 - Final report on the Test Sites

H2020 Coordination and Support Action
 Topic: MG-8-19-2024 (Smarter design, construction and maintenance)
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 Duration: 24 months

Effective and Coordinated Roads Infrastructure Safety Operations
 ECORoads

Deliverable DS.3
 Final Report on the Field Tests
 January 2017

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Due Date	27 th of January 2017
Delivery Date	28th of January 2017
Work Package	WP5 – Safe Road Safety Operations
Dissemination level	Public

Final Report Table of Contents:

For each test site:

- Introduction
- ➔ • Organizational details
- ➔ • Technical details
- Summary of the entire procedure
- Conclusions of the Internal Observer
- Summarized feedback of the Inspection Team

DS.3 - Final report on the Test sites



H2020 Coordination and Support Action
Topic: MG-8-1b-2014 (Smarter design, construction and maintenance)
Grant Agreement number: 652821
Start date: 01 June 2015
Duration: 24 months

Effective and Coordinated Roads Infrastructure Safety Operations
ECORoads

Deliverable DS.3
Final Report on the Field Tests
January 2017

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Due Date	27 th of January 2017
Delivery Date	28th of January 2017
Work Package	WP5 - Smart Road Safety Operations
Dissemination level	Public

Planning and Organizational details

According to Common Procedures and decisions taken at project meetings. All activities performed timely, with slight exceptions and minor problems.

Main remarks:

- 2-days operations
- Core Team: 2 road safety experts & 1 tunnel safety expert minimum
- No road users' groups represented
- Prior data provision ensured
- Briefing meetings: 2-3 hours
- Visit at Tunnel Control Centre: 1 hour
- Visits-inspections during daylight: 2 crossings in each direction (depending on the test site particularities)
- Visits-inspections on foot: 2 hours (depending on test site particularities)
- Working meetings for drafting preliminary findings/ RSI report: 2.5-3 hours
- Completion meetings: 1 hour

Technical details – Documents and data used

According to Common Procedures. All requested documents and data that had been available were provided to the experts, with minor problems.

Main remarks:

- Mostly designs and accidents statistics provided, as well as details for lighting conditions and traffic signals
- Data on accidents and analysis: not adequate in many cases
- Safety documentation and designs/ descriptions of recent interventions: only provided for one test site

Technical details – Safety during inspection

According to Common Procedures.
No safety issues emerged.

Main remarks:

- Adequate arrangements made & measures taken by hosts/organisers;
- Videos of infrastructure and of accidents: are very important to be provided;
- Exploitation of modern technology: extremely useful for preparatory works, for minimisation of inspection time on site and for reporting.



Technical details – Tools and methods

According to Common Procedures.

Main remarks:

- Checklists usage: very important ! (mandatory for 2nd set of field tests)
- Briefing and Completion meetings: very efficient
- RSA/RSI Reports according to Common Procedures
- Overview map with problems location only included in two of the RSA/RSI reports
- Summary of findings: not provided at all RSA/RSI reports
- Missing documents (not provided by IM) not mentioned in the reports
- Response of IMs provided during Completion Meeting and after RSA/RSI report submission (with delays in some cases)
- Feedback from participants (evaluation forms), with constructive comments received timely in all cases

Summary of the overall procedures

According to Common Procedures and project time schedule

Deadlines	Kennedytunnel	Krrabe	Rennsteigtunnel	Strazevica	Demir Kapija
Preparatory activities	01-02.2016	01-03.2016	05-07.2016	07-08.2016	09-10.2016
Field test	08-09.03.2016	05-06.04.2016	17-18.08.2016	27-28.09.2016	18-19.10.2016
Delivery of RSI Report	25.03.2016	27.04.2016	31.08.2016	19.10.2016	09.11.2016
Feedbacks (Evaluation Forms)	25.03.2016	25.04.2016	31.08.2016	19.10.2016	9.11.2016
Feedback from the IM on the RSI Report	04.04.2016	04.05.2016	31.10.2016	02.11.2016 and 16.11.2016	23.11.2016 and 07.12.2016
Delivery of the Internal Observer's Report	08.04.2016	09.05.2016	30.11.2016	30.11.2016	16.11.2016

Main remarks:

- Overall duration for all procedures to be completed (preparatory activities -->> delivery of all reports): 4-6 months
- Internal Observers reports submitted with delay, due to delayed response of IM

Feedbacks from the members of the Audit/Inspection Group

Presented in the Final Report of the Field Tests: incorporated in “Internal” Observers’ Reports and in Summarised Feedbacks and Conclusions

Taken into account in:

- **Deliverable D.6.1:** Preliminary Guidelines
- **Deliverable D.6.2:** Guidelines and Recommendations

Outcomes of the field tests (1/2)

RSI Reports: the final technical outcome for each field test with all identified deficiencies.

“Fixed obstacles” proved to be one of the major concerns of the experts, increasing the risk of severe injuries and fatalities:

- unprotected obstacles at tunnel portals;
- lay-bys, retaining or recession walls and cross passages in tunnels that have been constructed perpendicularly to the traffic direction;
- presence of concrete barriers (used as channelizing island or central reserve);
- presence of unprotected lighting poles, signs or VMS poles and bridge pillars; and
- inappropriate finishing of guardrails/ crash barriers endings and missing or interrupted/ damaged guardrails/ crash barriers.

Outcomes of the field tests (2/2)

Open Roads	Transition Areas	Tunnel Interior
Existence of damaged road signs		
Damaged pavement (ruts, potholes)		
Absence of rumble strips or poor contrast provided by the existing road marking		
Inappropriate speed limits		Illuminated signs inside tunnel not functioning or not visible due to dirt
Inappropriate transition between different types of safety barriers		Existence of high dismissive sidewalks, endangering loss of control of vehicle and impeding cars to drive at the side to clear the way for emergency crews
Missing road signs, e.g. diverting dangerous goods vehicles	Landslides, with damaged road equipment	Existence of other obstacles not favoring pedestrians movement in case of emergency situations to access Emergency doors and equipment
Existence of multiple (overlapping) and ambiguous (contradictory) road signs	Absence of adequate regulatory signage for prevention of users from inappropriate use of emergency central median openings in front of the tunnel	Absence or inadequacy of signage of emergency equipment, e.g. phones, fire extinguishers
Roadside or median vegetation and plantings reducing sight distance in horizontal curves and visibility of signs	Existence of distracting signs and advertising labels near the portal area	Inappropriate interval between successive VMS for lane closures in case of incident
Existence of high gradient steep before the tunnel that could cause engine or brakes overheating of heavy vehicles	Existence of access-service roads in the transition areas without appropriate regulatory signage and barriers	Narrow access to vehicles cross-passage between tunnel tubes, to be used in case of evacuation need; existence of locked doors of fire hydrant niches
	Illumination conditions, e.g. lights not functioning, type of light, uniformity of lighting	
	Not functioning or malfunctioning VMS	
	Absence or dirtiness of retroreflective road equipment	
	Late or missing directional signage for weavings using exit-entry ramps before and after a tunnel	

The success of the Joint Road Safety Operations: from the experts feedback

The deficiencies observed covered several aspects from the road safety and not tunnel-only point of view, due to the **exchange of observations and experiences** between the road and tunnel experts (*different scientific background, different legal framework, design and safety standards and practices in origin countries*).

Cooperation among the experts of the Core Team was smooth and efficient, on-site and in-house.

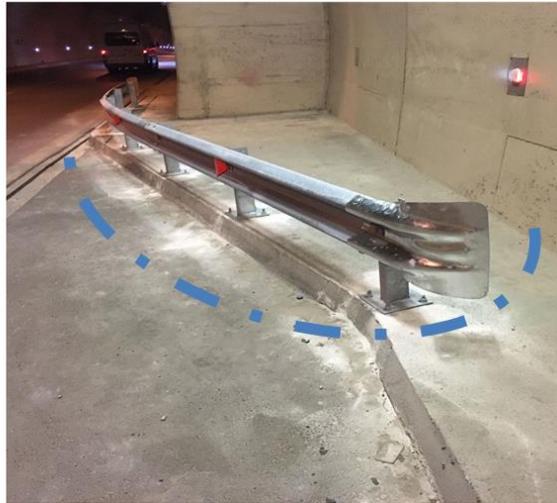
Another added value: the **cooperation and exchange of views, experiences and practices between all participants, including national road authorities and IMs**.

The success of the Joint Road Safety Operations: from the Infrastructure Managers feedback

Already implemented measures by the IMs:

- restoration of safety barriers (guardrails) continuity and uniformity;
- prevention of usage of emergency opening of median before tunnel entrance by increasing the density of portable barriers;
- relocation of vertical signage, addition of concrete layer finishing at drop-off at the pavement edge;
- installation of safety barriers and other custom-made crash cushions at perpendicular walls;
- removal of temporary signs that had remained after works completion;
- removal of excessive and ambiguous road signage, restoration of road marking (consecutiveness of stripes);
- addition of missing signage;
- cleaning of walls and reflective equipment; and
- VMS repair and improvements.

The success of the Joint Road Safety Operations: from the Infrastructure Managers actions



Installation of guardrail in front of perpendicular wall of lay-by in Krrabe tunnel (source: Hasani A., Albanian Roads Authority)



Removed ambiguous road signs along the open road section at Strazevica tunnel (source: Jerinic D., Public Enterprise Roads of Serbia)



Effective and COordinated ROAD infrastructure Safety operations

Deliverables and documents in the Library section, public part.

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