SAVeRS
Selection of Appropriate Vehicle Restraint Systems

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Vehicle Restraint Systems (VRS)

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The issue is well summarized in this chart developed by ERF …

Conférence Européenne
des Directeurs des Routes

Conference of European
Directors of Roads

CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME

Call 2012

Safety:

- Safety of road workers and interaction with road users
- Use of vehicle restraint systems

Cross-border funded Transnational Research Programme funded by Belgium/Flanders, Germany, Ireland, Norway, Sweden, United Kingdom

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Selection of Appropriate Vehicle Restraint Systems

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vti

TRINITY COLLEGE DUBLIN

TRL

ZAG

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

Parsons Brinckerhoff

Subcontractor: BRRC

Project Managers:

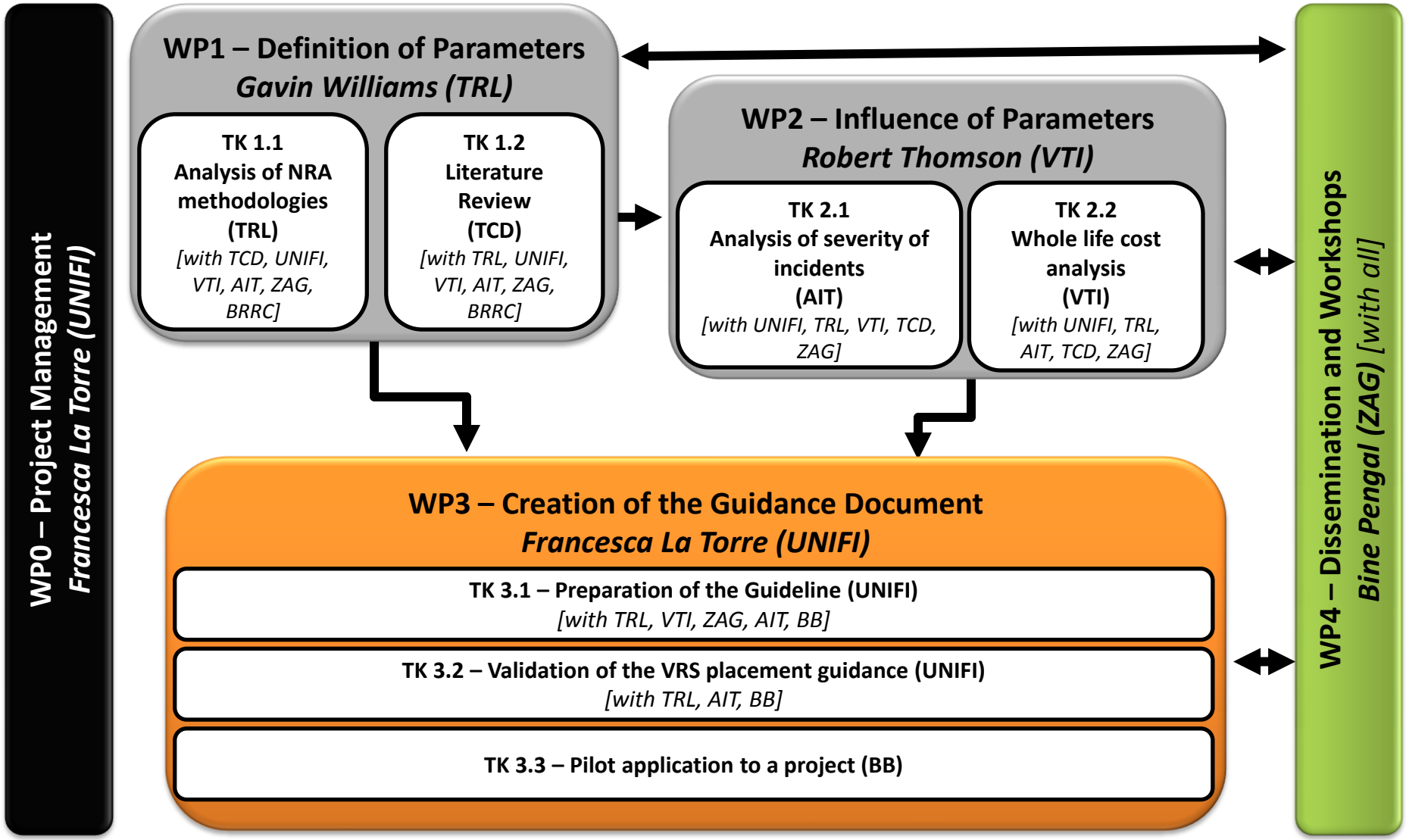
Alastair De Beer – NRA, Ireland

Anders Hakansson – Trafikverket, Sweden

Objectives of SAVeRS

The objective of the SAVeRS project is to produce a **practical and readily understandable Vehicle Restraint System (VRS) guidance document** and a user-friendly tool that will allow the **selection of the most appropriate solution in different road and traffic configurations for all types of VRS.**

Workplan of SAVeRS



Timetable of SAVeRS

January 1, 2013

December 31, 2014

WP	TASK		WP LEADER	TK LEADER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP 0		**PROJECT MANAGEMENT**	**UNIFI**																									
WP 1		**DEFINE THE DIFFERENT PARAMETERS WHICH INFLUENCE THE CHOICE OF VRS (F1)**	**TRL**																									
	TK 1.1	Analysis of the different NRA methodologies		TRL																								
	TK 1.2	Detailed literature study on the use of VRS worldwide.		TCD																								
WP 2		**ANALYSE THE DIFFERENT PARAMETERS WHICH INFLUENCE THE CHOICE OF VRS (F2)**	**VTI**																									
	TK 2.1	Analyse the severity of incidents in relation to the used VRS		AIT																								
	TK 2.2	Whole life cost analysis for different types of VRS		VTI																								
	TK 2.3	Review of Type Approval information and EN Norms Related to VRS Performance		UNIFI																								
WP 3		**CREATE A GUIDANCE DOCUMENT (F3)**	**UNIFI**																									
	TK 3.1	Preparation of the guideline		UNIFI																								
	TK 3.2	Pilot application to a project		BB																								
WP 4		**DISSEMINATION & WORKSHOP ORGANIZATION**	**ZAG**																									

PROJECT MILESTONES

Progress Report to CEDR TG on Road Safety

Total Budget of 525 k€ (approx. 700 k US$)

WP 1 - Completed

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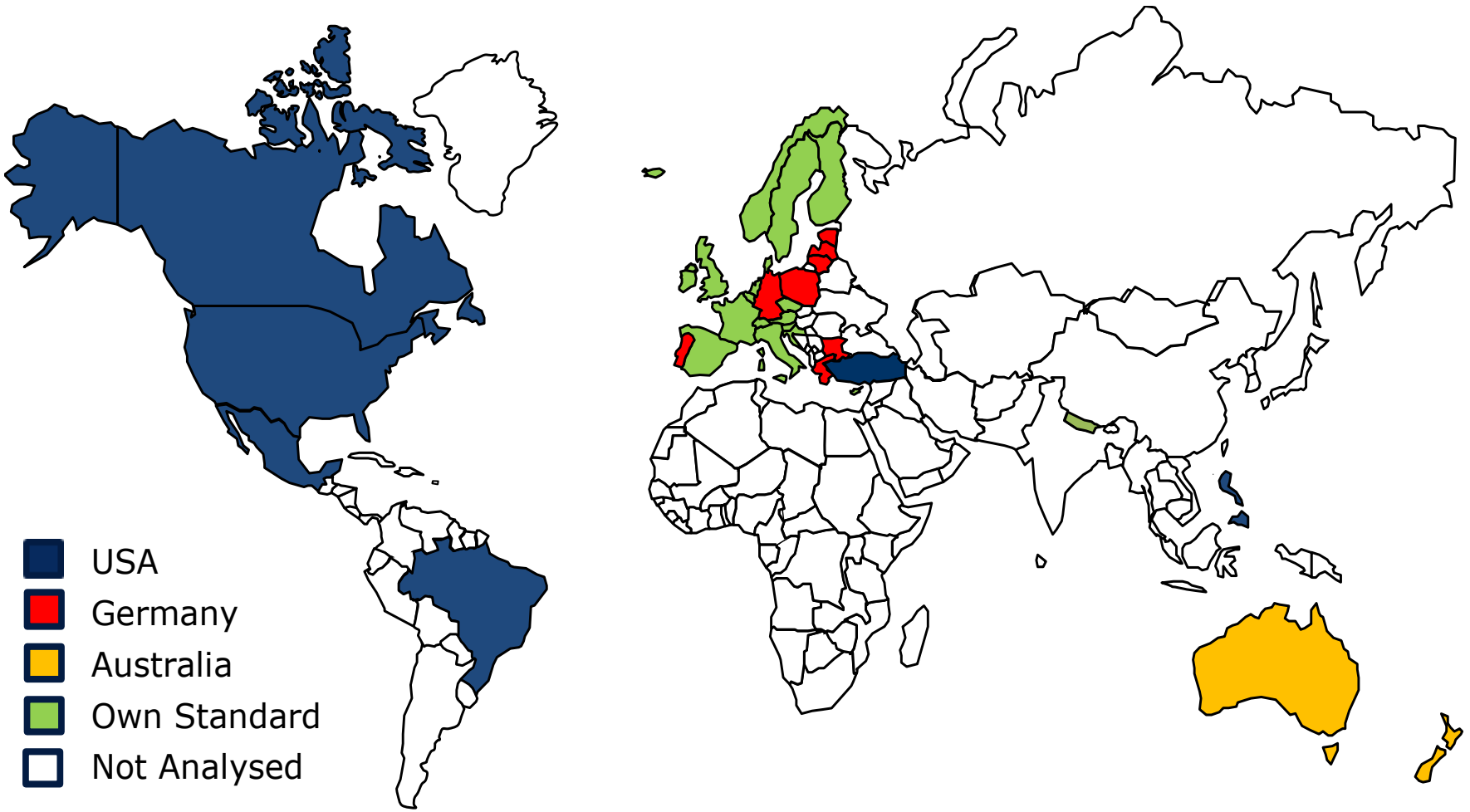

WP 1 - Completed

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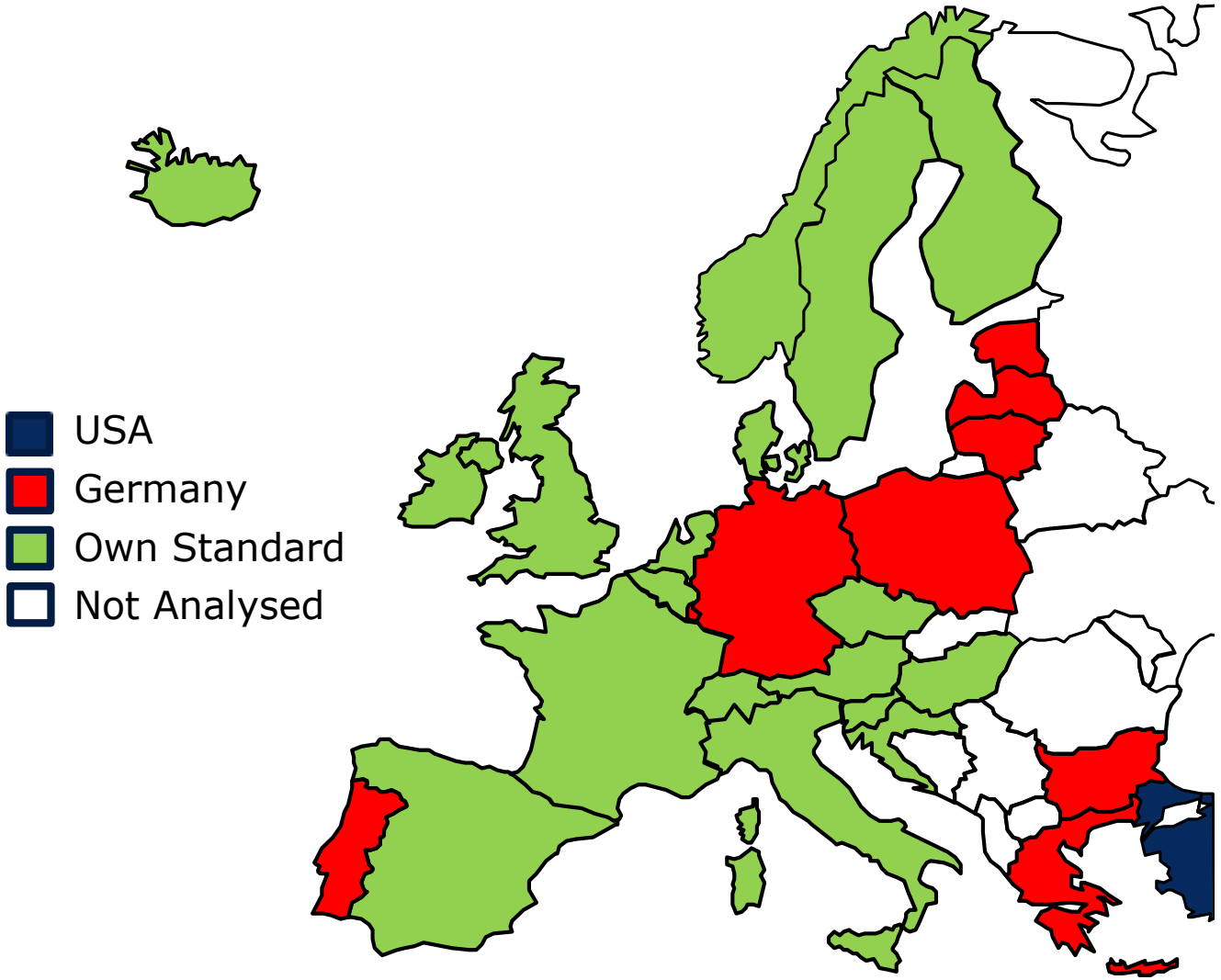

Identification of key parameters

- **37 different national standards have been collected and analysed comparing them (when possibile) in terms of:**
  - ✓ General parameters;
  - ✓ Barriers;
  - ✓ Crash cushions;
  - ✓ Bridge parapets;
  - ✓ Terminals;
  - ✓ Transitions;
  - ✓ Truck Mounted Attenuators (only limited to this phase)
  - ✓ Motorcyle Protection Systems

Two parallel issues

Decision on where a VRS is needed (mostly based on the probabilty of having an harmful event)

Decision on the minimum VRS performance (mostly based on the potential consequences of the event)

The parameters used in the different standards are not the same for the two issues

CEDR Transnational Road Research Programme
Call 2012: Safety:
Use of Vehicle Restraint Systems

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Conference of European Directors of Roads

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Defining the Different Parameters which can influence the need and selection of VRS

Deliverable D1.1
Sep 2014

Partners:
University of Florence, Italy
TRL Ltd, United Kingdom
Swedish National Road and Transport Research Institute, Sweden
Trinity College Dublin, Ireland
Slovenian National Building and Civil Engineering Institute, Slovenia
AIT Austrian Institute of Technology GmbH, Austria
Parsons Brinckerhoff, United Kingdom
Belgian Road Research Centre, Belgium

Transport Research Arena 2014, Paris

Development of a guideline for the selection of Vehicle Restraint Systems - identification of the key selection parameters

Francesca La Torre[a]*, Ceki Erginbas[b], Robert Thomson[c], Giuseppina Amato[d], Bine Pengal[e], Peter Saleh[f], Chris Britton[g], Kris Redant[h]

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(c)Swedish National Road and Transport Research Institute, Sweden
(d) Trinity College Dublin, Ireland
(e) Slovenian National Building and Civil Engineering Institute, Slovenia
(f) AIT Austrian Institute of Technology GmbH, Austria
(g) Parsons Brinckerhoff, United Kingdom (h) Belgian Road Research Centre, Belgium

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WP2 -Collection of crash data

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National crash data → **Country Reports**

National datasets at network level (less detailed but very extensive datasets) → **Run-off road model**

In depth investigations (detailed data but limited amount of crashes considered) → **Encroachment model (angle and speed)**

WP2 – Run-Off-Road model (motorways)

The principles:

- ✓ **There cannot be a single ROR model for all Europe and for all roads;**
- ✓ **A single model functional form can be developed and then this can be calibrated to adapt to local crash data;**
- ✓ **The form has been developed as a base prediction model and a set of CMFs;**
- ✓ **Depending on the type of data available different "model adaptations" can be performed (overall calibration, calibration of some CMFS etc)**

$$N = C \times N_{base} \times CMF_1 \times CMF_2 \times CMF_3 \ldots.$$

WP2 – Run-Off-Road model (motorways)

$$N = C \times N_{base} \times CMF_1 \times CMF_2 \times CMF_3 \ldots.$$

N_{base} = Base ROR Model (for standard conditions: straight, flat, 2 lanes, 3 m outer shoulder ….)

The user can fit the model function to local data and enter local coefficients

The user can select one of the models given in the SAVeRS tool

WP2 – Base ROR Model (motorways)

$$SVROR = Sec\_Length \cdot e^{\beta_0 + \beta_1 \log(AADT)}$$

	Dependent variable				
	SVROR				
	AIT	TCD	TRL	UNIFI	VTI
	(1)	(2)	(3)	(4)	(5)
log_AADT					
Constant					
Observations					
Log Likelihood					
theta					
Akaike Inf. Crit.					
Note:	*p<0.1; **p<0.05; ***p<0.01				

WP2 – CMFs (motorways)

$$N = C \times N_{base} \times CMF_1 \times CMF_2 \times CMF_3 \ldots$$

- ✓ Number of lanes (CMF_L)
- ✓ Outside Shoulder Width (CMF_{OSW})
- ✓ Inside Shoulder width (CMF_{ISW})
- ✓ Gradient (CMF_G)
- ✓ Rumble Strips (CMF_{RS})
- ✓ Lane width (CMF_{LW})
- ✓ Horizontal Curve (CMF_{HC})

Derived from the literature for ROR or single vehicle crashes

WP2 – CMFs (motorways)

To allow for a simpler use variable classes have been defined

Example

Table 1: CMF for increasing the outside shoulder width (CMF_{OSW})

Shoulder width [m]	Median [m]	Median [feet]	CMF_{OSW}
≤ 1.00	not applicable		
1.01–1.50	1.25	4.10	1.37
1.51–2.00	1.75	5.74	1.24
2.01–2.50	2.25	7.38	1.11
2.51–3.00	2.75	9.02	1.00
3.01–3.50	3.25	10.66	0.90

WP2 – Calibration of the full ROR model (base + CMF)

$$N = C \times N_{base} \times CMF_1 \times CMF_2 \times CMF_3 \ldots.$$

$$C = \frac{\sum_{i=1}^{all\ sites} N_{observed}}{\sum_{i=1}^{all\ sites} N_{predicted}}$$

For Ireland the infrastructure data to calculate the CMFs were not available

Country	C-value
Austria	
~~Ireland~~	
Italy	
Sweden	
UK	

WP2 – Encroachment model

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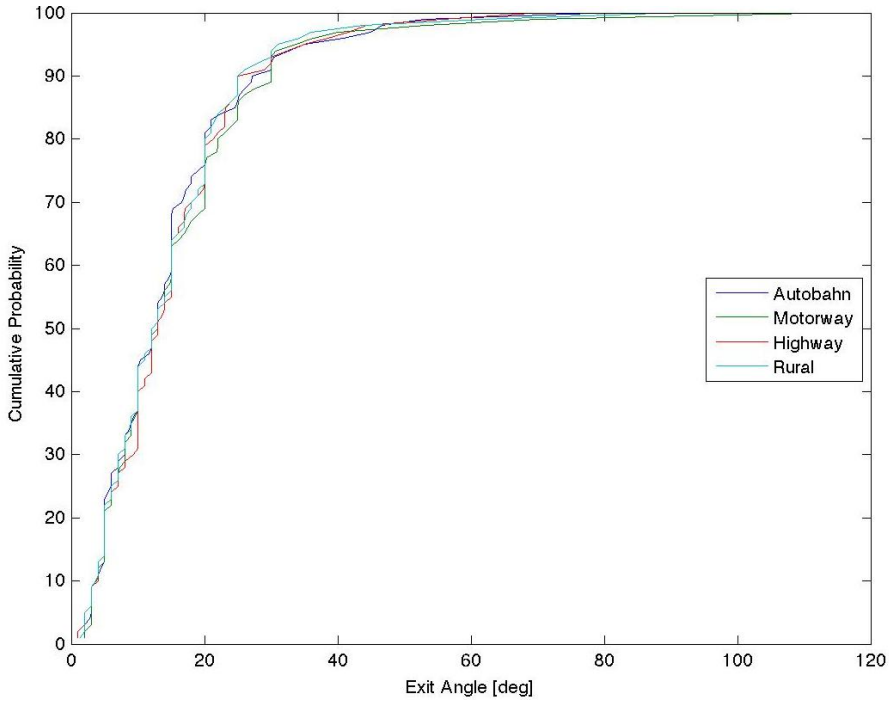
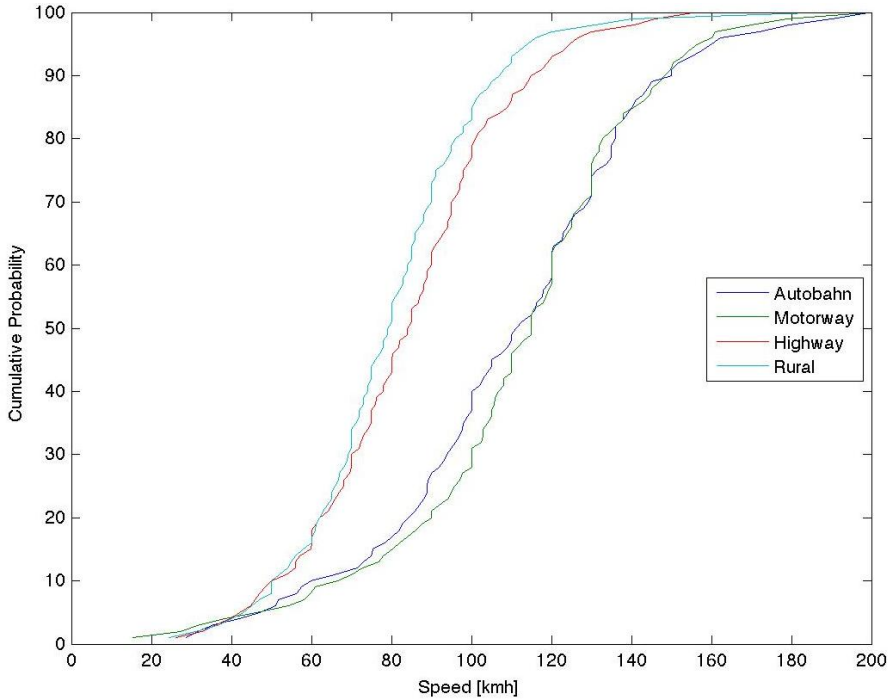
Not a single model but different distribution curves



Germany



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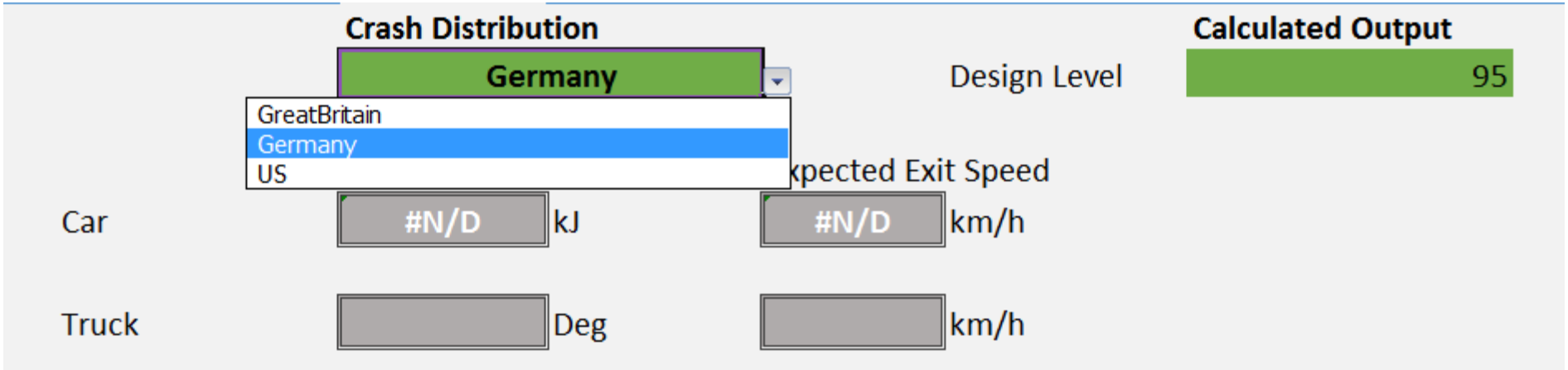
WP2 – Encroachment model

Not a single model but different distribution curves

Germany



The user has to choose the design crash distribution and design percentile and angle and speed is given (different for cars and trucks)

WP2 – Life cycle costs

- ✓ ***Societal Costs***
- ✓ ***Hardware related costs***
- ✓ ***Safety Consequences***
- ✓ ***Implementation***

WP2 – Life cycle costs

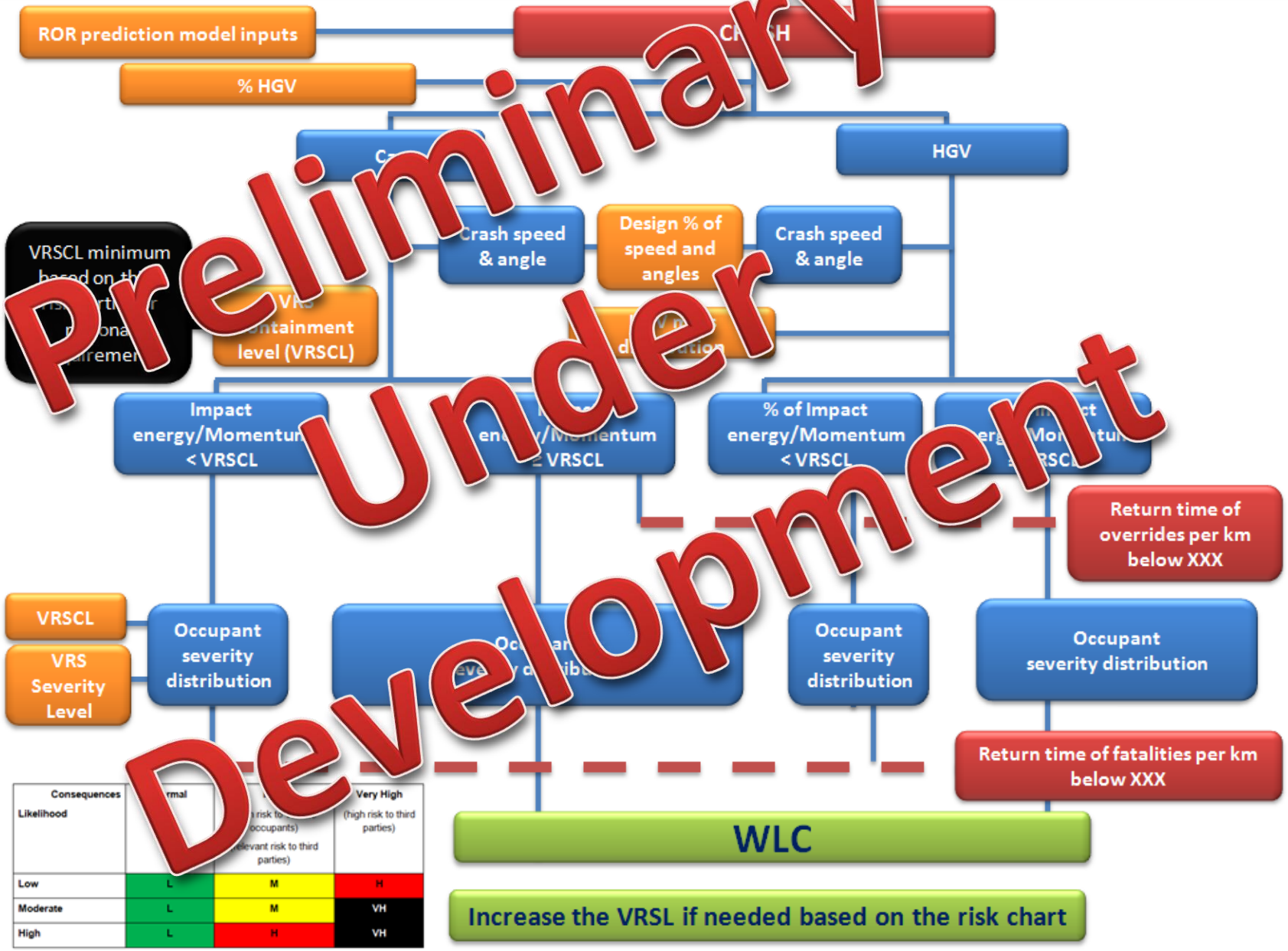
Safety Consequences (SDF)

$$P_{fs+sc,ac,at,K} = \frac{\exp(V_K)}{\frac{1.0}{C_{sdf,fs+sc}} + \exp(V_K) + \exp(V_A) + \exp(V_B)}$$

The default SDF is the Highway Safety Manual (2013) SDF for Freeways but this can be changed by the user

Italy	Proportion of Injuries/Accidents
Car	
Truck	
MC	

WP2 – VRS Selection guideline



User Friendly Tool

As far as different countries, as well as different designers within a country, have different level of expertise and different data availability, the system need to be structured with different possible application levels.

Very detailed data available → **Full SAVeRS Selection procedure**

Some data available → **Reduced SAVeRS Selection procedure**

No data available → **Default selection criteria (different sets)**

User Friendly Tool

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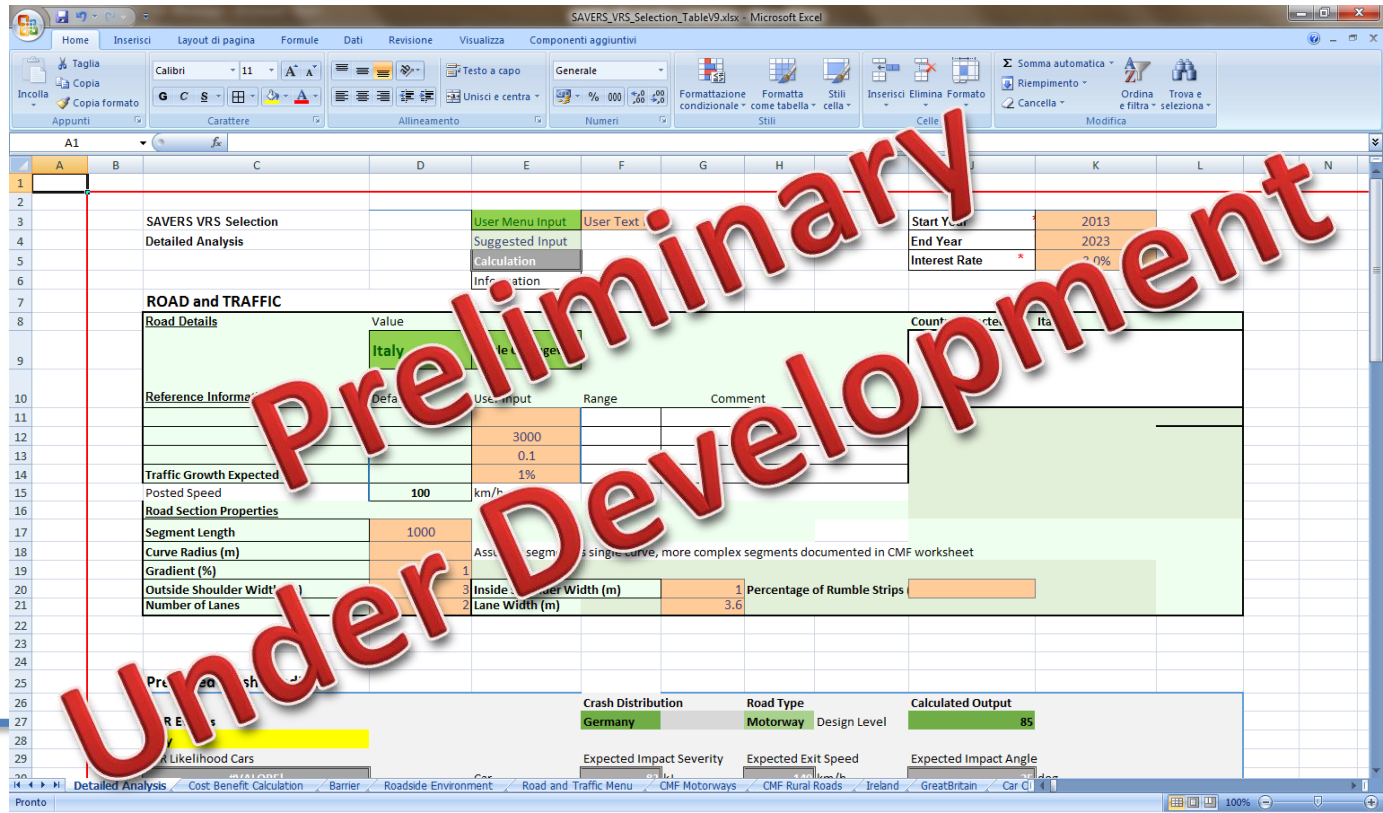
Excel spreadsheet with MACROs

Different default values are given from the datasets analysed in SAVeRS

The user can input locally derived parameters



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For more details

SAVeRS Selection of Appropriate Vehicle Restraint Systems

CEDR Conférence Européenne des Directeurs des Routes / Conference of European Directors of Roads

Home | About project | Structure | Facts & Contacts | Downloads | Team | National Guidelines | Useful links

Downloads

Deliverables

No	Deliverable Name / Report Name	Due date
1	Data matrix and report (D1.1) SAVeRS_WP1_Deliverable_1_1 (pdf, 5.53 MB)	Month 10
2	Mid Term Assessment Report (Private) (D0.1)	Month 12
3	Report on VRS Safety Performance under Real World Conditions including Financial Implications (D2.1)	Month 18
4	Guideline for the selection of Vehicle Restraint Systems (D3.1)	Month 24
5	On line tool for the implementation of the guideline (D4.1)	Month 24
6	User manual for the on line tool (D4.2)	Month 24

Downloads

Presentation Name	Download
SAVeRS_TRB_Presentation_January 2013	PDF (894MB)
SAVeRS_TRB-ERF_Presentation_April2013	PDF (2.57MB)
SAVeRS_TRB_Presentation_July2013	PDF (2.21MB)
SAVeRS_TRB_Presentation_January2014	PDF (2.65MB)
SAVeRS_ERF_Presentation_February2014	PDF (5.88MB)
SAVeRS_TRA_Presentation_April2014	PDF (3.80MB)

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www.cedr.fr

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Forgiving roadsides design guide

November 2012

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If you are interested in accident modeling

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www.practproject.eu

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funded by Germany, Ireland, UK and Netherlands

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PRACT

Predicting Road ACcidents - a Transferable methodology across Europe

Project outline

Università degli Studi Firenze DICEA

Technische Universität Berlin

Imperial College London

With the support of:

autostrade per l'italia

IRF

ERF

TRB ANB25 Committee

pract

www.practproject.eu

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NRA An tÚdarás um Bóithre Náisiúnta National Roads Authority

Conference, 15 October 2014

Thank you .....