TRAFFIC
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Power-Two Wheelers Critical Risk Factors
A European Study

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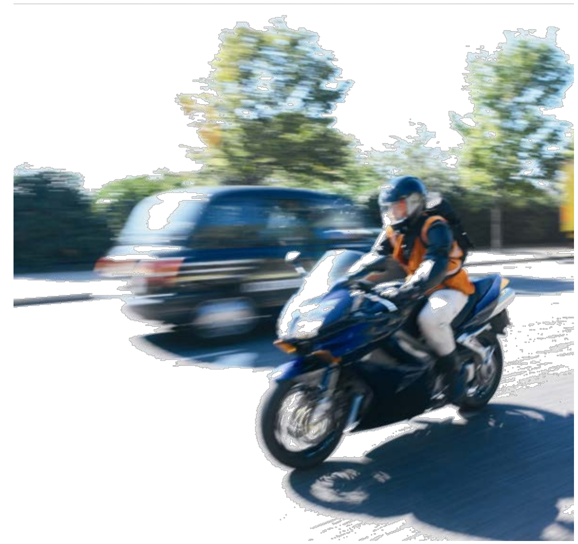
The 2BESAFE project

- Research on Power Two Wheeler (PTW) crash causes and human error
- The world's first naturalistic riding experiment involving instrumented PTW
- Research on motorcycle rider risk awareness and perception
- Development of new research tools
- In-depth research on PTW crash factors
- Development of recommendation for practical counter measures

Powered-Two Wheelers

- PTWs is an individual transport mean
- Share the same operational environment of car and trucks but have huge differences from the rest of vehicles



- PTW riders with high risk and accident involvement

Powered-two Wheelers

- Several PTW-related research projects have already been undertaken in Europe:
  - To better understand rider accidentology (e.g. MAIDS, RIDER);
  - to improve PTW passive safety (e.g. APROSYS SP4, MYMOSA, SIM, COST 357-PROHELM);
  - to use ADAS and IVIS to improve riders' safety (e.g. WATCH-OVER, PreVENT, TRACE, SAVE-U);
  - to understand the sociology of PTW riders (e.g., MAIDS);
  - **To study of the normal (or naturalistic) behaviours of PTW riders in normal and emergency riding situations → 2-BE-SAFE**

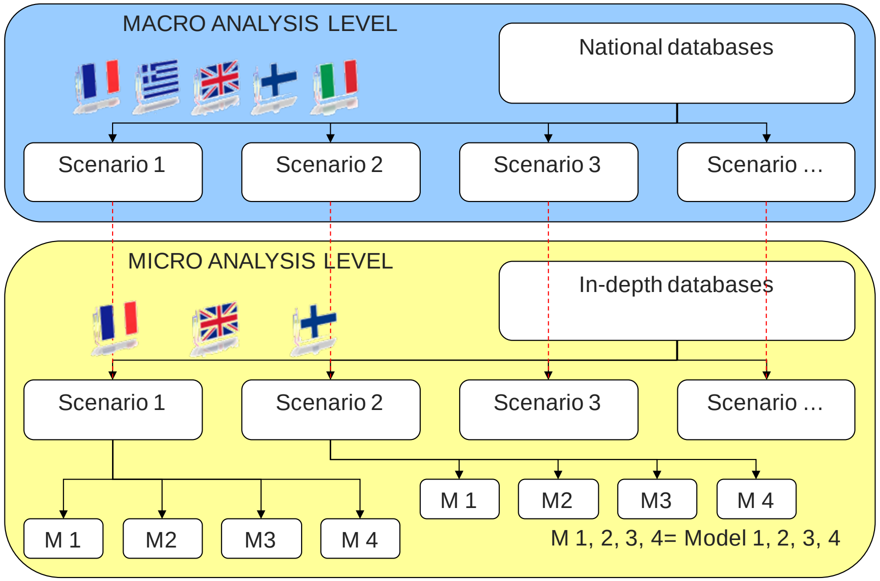
Scope

- To study the interactions of PTW accidents with:
  1. Rider/Driver Behavior
  2. Infrastructure
  3. Weather

- Questions addressed:
  1. What knowledge has already been obtained for each road user?
  2. What are the most relevant accident configurations at European level?
  3. Why accidents of those configurations take place?

Rider-Driver Interactions

- Methodology
  - Analyses in macro and micro level (2 years period, from 2006 to 2007)



Rider-Driver Interactions

- Prevailing PTW accident scenarios were identified
  - 20 PTW accident configurations were detected, common or not to the five countries involved.
- 9 accident scenarios were selected for further analysis.
  - For example single moped/motorcycle accidents inside/outside urban area, accidents between a moped/motorcycle and other vehicle and so on

Rider-Driver Interactions

- Critical factors from Microscopic Analysis:
  - Perception of drivers/riders
  - Human errors
    - failure in perceiving the moped by another vehicle driver
    - Loss of control when experiencing a guidance problem
    - poor reaction to an external distraction due to excessive speeds, risk taking, and so on
  - Collision type (rural/urban, PTW single accident or more than one vehicle accidents etc)
  - Conspicuity, perception of drivers for motorcycles

Road Infrastructure

- Macroscopic analysis - Data
  - Accident statistics from national databases of Greece, Spain, Great Britain and Italy from 2005 to 2007
  - Basic framework of comparable queries
  - Specific queries and cross-tabulations for “extra benefits”

Road Infrastructure

- Risk factors:
  - Type of area (inside / outside urban area)
  - Junction type (Intersection or not)
  - Type of collision
  - Road geometry
  - Specific results
    - curves and descending gradients (Greece)
    - Roundabouts and age (GB)
    - Less front to side accidents at roundabout in comparison to other junction types, however more sidewipe accidents (Spain)
    - Accidents on wet and slippery roads are less severe than on dry roads (Italy)

Road Infrastructure

- Microscopic Analysis Methodology
  - In-depth accident data analysis (CIDAUT)

  - Linkage of crash data, road geometry data and road surface data using special measurement vehicle and software tools (BASt, AIT)

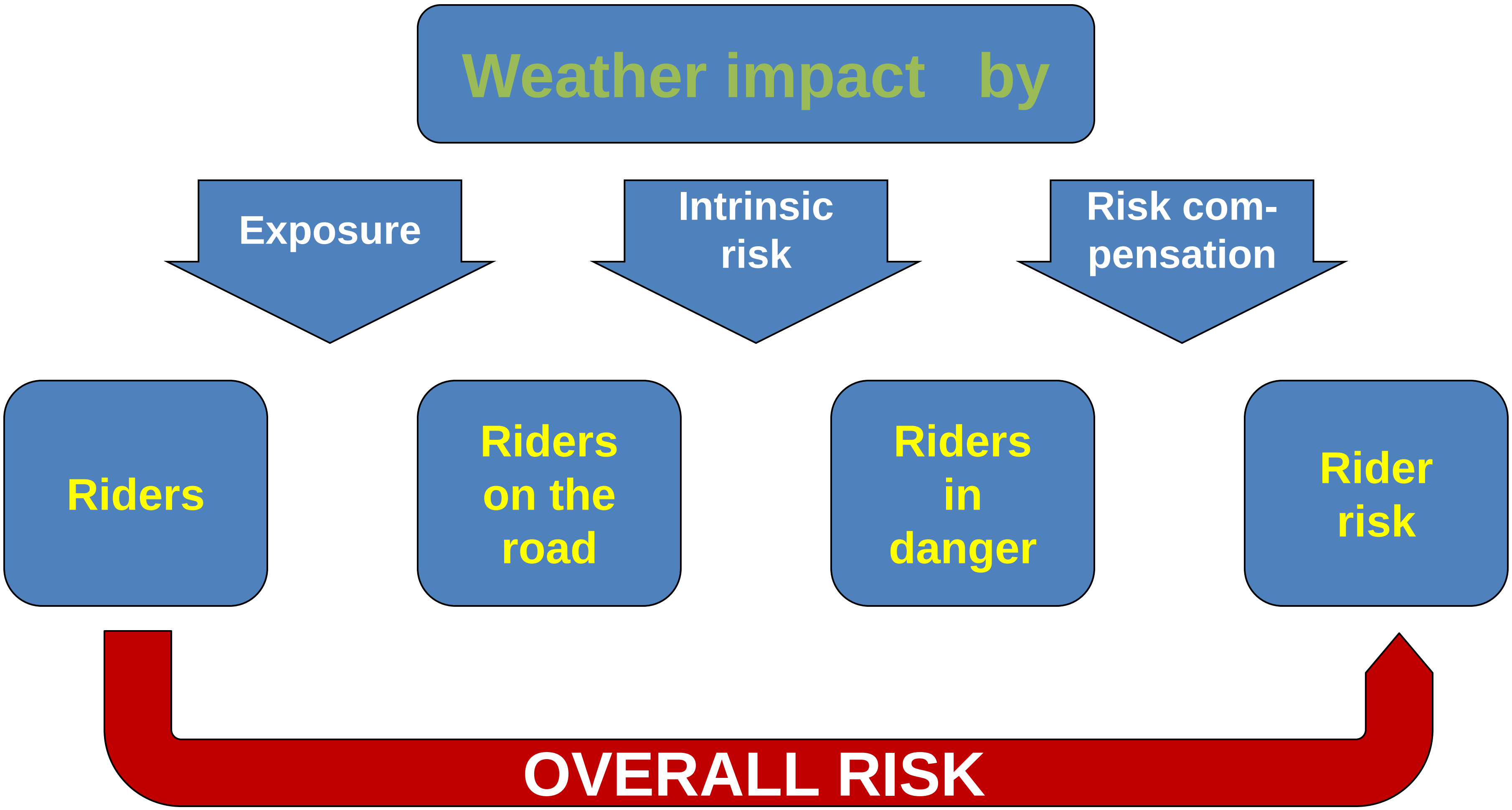
Road Infrastructure

- Risk factors from microscopic analysis
  - Critical sequence of curve radii (especially consecutive curves with very different or with decreasing curve radii)
  - Left curves (especially in sections with descending gradient)
  - Critical curve radii lower than 100m
  - Deficits concerning the longitudinal evenness and the transversal evenness seems to present risk factors for PTW rider

Weather Conditions

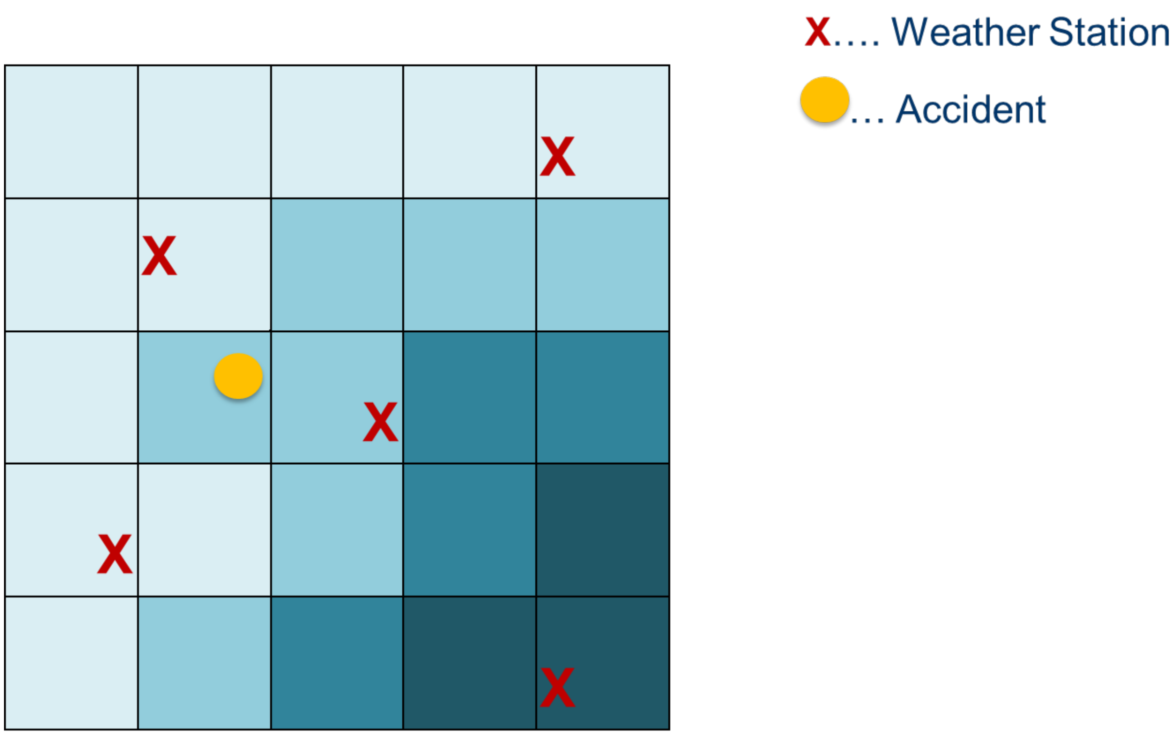
- Problem:
  - Accident statistics biased by weather conditions
- Literature:
  - Hardly anything controlled for exposure
  - Nothing about PTWs
- Macroscopic Analysis:
  - Executed, but no solution

Weather Conditions

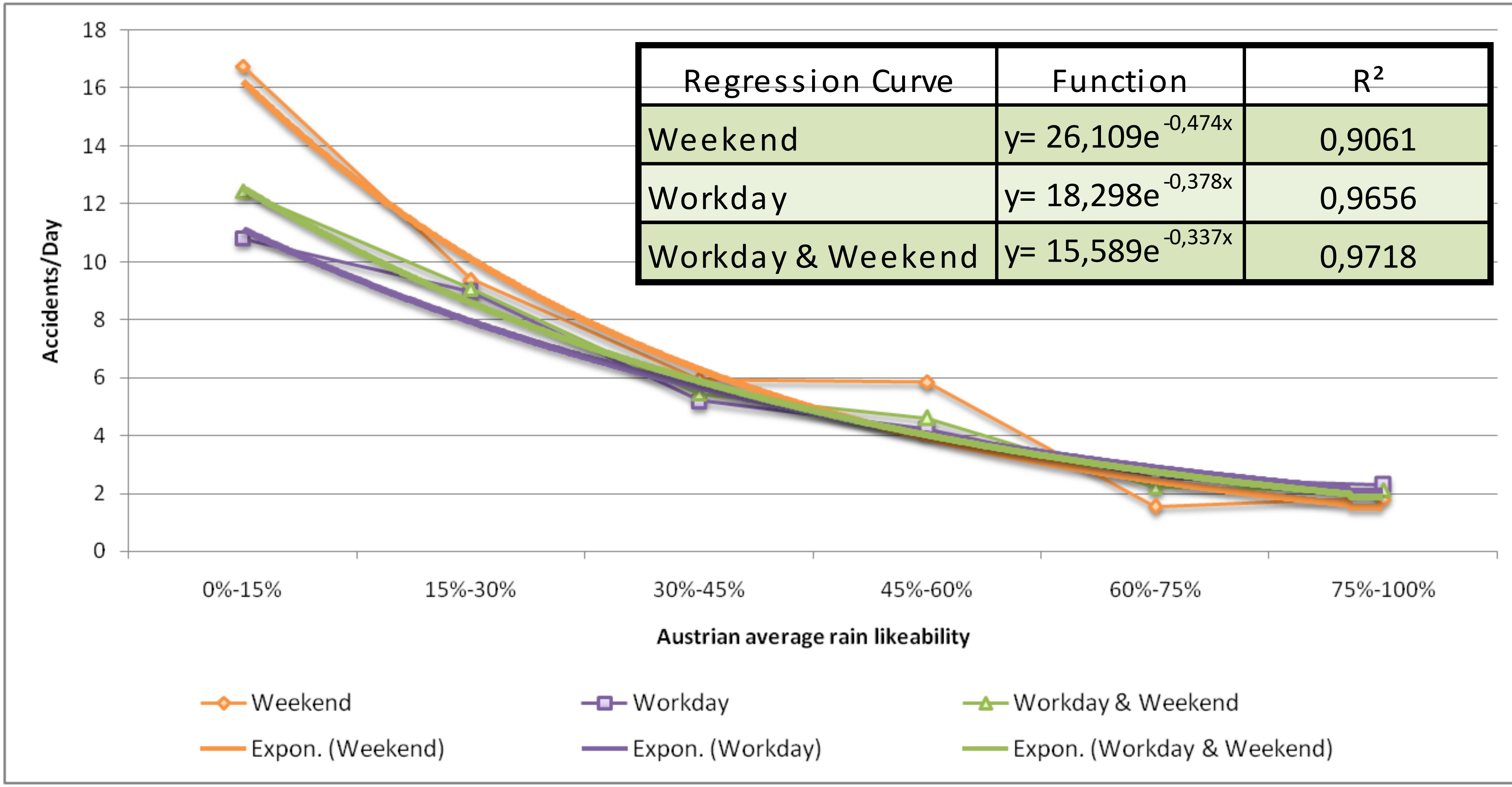


Weather Conditions

Methodology and data



Weather Conditions - Findings



Regression Curve	Function	R^2
Weekend	$y= 26{,}109e^{-0{,}474x}$	0,9061
Workday	$y= 18{,}298e^{-0{,}378x}$	0,9656
Workday & Weekend	$y= 15{,}589e^{-0{,}337x}$	0,9718

Weather Conditions

Precipitation	Days			Accidents			Statistical values	
	2002	2003	2004	2002	2003	2004	Function	Coefficient of determination
0%-15%	210	245	196	2610	3179	2548	13,527x-156,46	0,9637
15%-30%	55	60	61	265	321	383	16,935x-670,55	0,8507
30%-45%	47	35	57	192	77	244	7,6566x-183,76	0,9740
45%-60%	35	14	29	128	32	94	4,4872x-32	0,9943
60%-75%	14	8	13	35	7	33	4,8387x-31,452	0,9915
75%-100%	4	3	10	9	1	16	1,8023x-1,5465	0,8265
Total	**365**	**365**	**366**	**3239**	**3617**	**3318**		**0,9478**

- 95% of variance can be explained by variation of weather conditions
- Mission completed!
- Exposure data needed to proceed

Summary of critical PTW risk factors

Element	Macroscopic Analysis	Microscopic Analysis
Rider/Driver Behavior	Prevailing PTW accident scenarios with respect to: • the number of vehicles (including pedestrians) involved in the accident., • the area of the accident (outside or inside urban area), • accident occurring at a junction or not and the type of the opponent (vehicle) in the accident	moped riders: • age, experience • riding frequency • state of moped • PTW apparel • Human errors (looking but not seeing, failure in perceiving the moped) • voluntary risk taking behavior conspicuity • lack skills and knowledge about riding. Motorcycle riders: • age, experience • human functional failures (loss of control when experiencing a guidance problem or the poor reaction to an external distraction due to excessive speeds, risk taking) • the lack of perception (from the passenger car driver and of the motorcyclists) • conspicuity (the driver fails to see the motorcyclist)
Infrastructure	The type of area Carriageway type Road Installations and stationary objects Pavement surface conditions Junction type Geometry specifications	Crossfall and curve radius (radii smaller than 200m) curvature change rate Black spots for passenger cars Deficits (general unevenness for example are road surface waves as well as potholes) friction value accumulation of bituminous binders and ruts Not-predictable road geometry
Weather Conditions	Meteorosensitivity Precipitation intensity Snowfall	PTW accidents correlate with weather conditions. This correlation can be described in mathematical terms. The accident record of a year can be normalized using a correlation between accidents and weather conditions. The correlations between weather and accident numbers differ for weekends and workdays.

Concluding Remarks

- The synthesis of the results from the macroscopic and in-depth studies reveals the complete size and the characteristics of the road accidents phenomenon.

- The use of different accident configurations adds value to the analysis results.

Concluding Remarks

- Exposure disaggregate data (veh-kms etc) are necessary for the identification of accident risk.

- Datasets should be reliable, compatible and comparable across Europe through the use of common collection form.

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