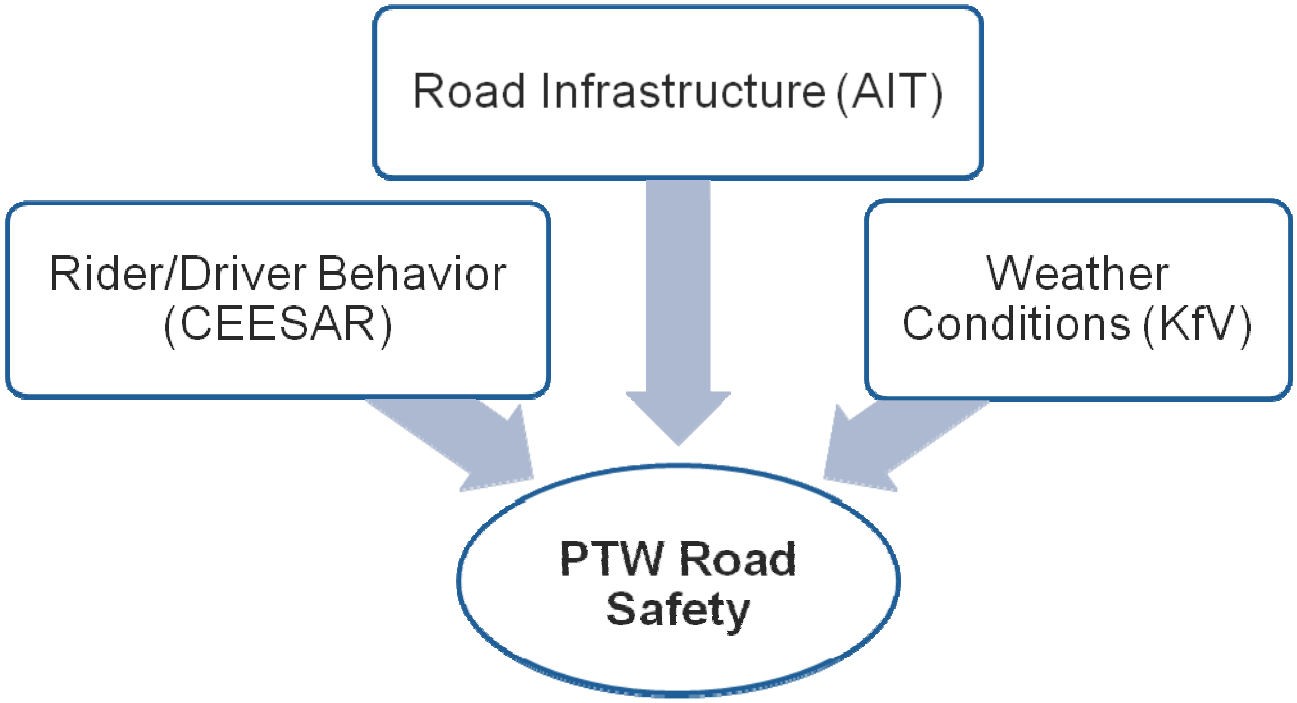
Powered Two Wheeler critical risk factors Behaviour - Infrastructure - Weather

John Golias, George Yannis, Eleni Vlahogianni, NTUA
Phan Vuthy, CEESAR - Peter Saleh, AIT – Martin Winkelbauer, KfV

- Describe the interactions between PTW accidents and…



Description of Work

- Duration:
  - January 2009 to June 2010
- Partners:
  - INRETS, CEESAR, TUD, BAST, UNIFI, TRL, AIT, KfV, UNIVIE, NTUA, CIDAUT, VTT
- Reporting – Deliverables
  - State-of-the-Art Report (M5 internal)
  - D1 - Rider/driver behaviours and PTW safety
  - D2 - Road infrastructure and PTW safety
  - D3 - Weather conditions and PTW safety

Available at www.2besafe.eu

Research Questions

1. What knowledge has already been obtained for each road user?

   → *Literature Review*

2. What are the most relevant accident configurations at EU level?

   → *Descriptive Analysis*

3. Why accidents of those configurations take place?

   → *In-depth Analysis*

Common methodological framework to all activities

State-of-the-Art

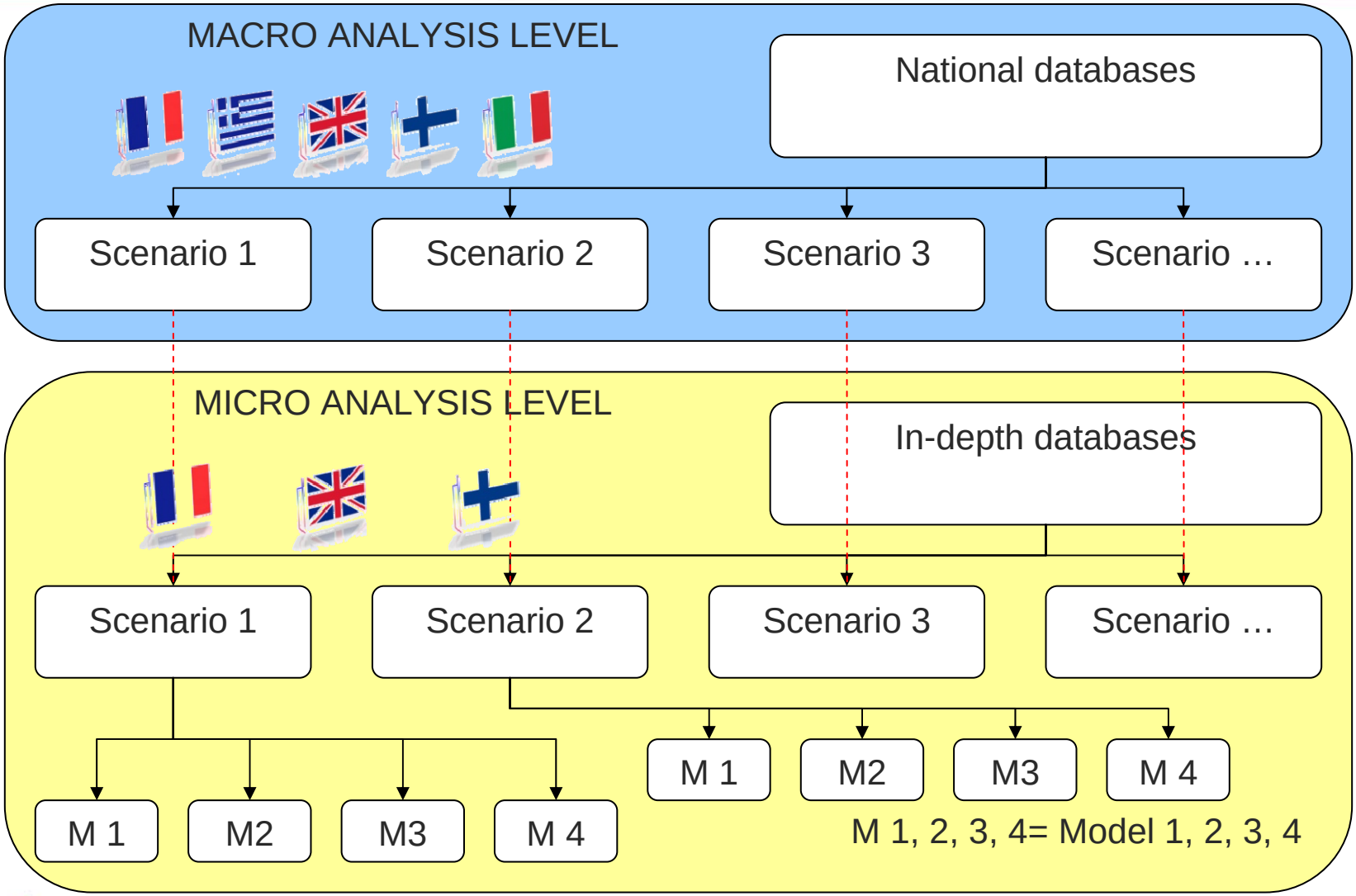
Risk Factor	Interaction	Magnitude	Need for Further Research
Roadway design defects	Infrastructure	High	Low
Roadway maintenance defects	Infrastructure	High	Low
Road surface condition	Infrastructure	High	Low
Collision with road side barriers in a run-off accident	Infrastructure	High	Low
Critical curve radii	Infrastructure	Low	Low
“Negative” crossfall	Infrastructure	Low	Low
Combined effect of crossfall, gradient and direction of curve	Infrastructure	High	Low
Intersections	Infrastructure	High	Low
Road markings, manhole covers and cattle guards	Infrastructure	Low	Low
Speeding	Rider/Driver Behavior	High	Low
Riding/Driving Attitudes and Patterns	Rider/Driver Behavior	High	High
Age, Gender and experience	Rider/Driver Behavior	Low	Low
Licensing, Education and Training	Rider/Driver Behavior	High	Low
Perception of drivers/riders and human errors	Rider/Driver Behavior	High	High
Drivers’ Perception of motorcycles	Infrastructure/vehicle	Low	Low
Alcohol and other impairments	Rider/Driver Behavior	High	Low
Personal Protective Equipment	Rider/Driver Behavior	Low	Low
Sociological considerations	Rider/Driver Behavior	Low	Low
In vehicle design elements and systems	Vehicle	Low	High
Conspicuity	Vehicle	Low	High
Braking	Vehicle	High	Low
Type of PTW	Vehicle	High	Low
Engine performance	Vehicle	High	Low
Precipitation	Weather	High	High
snowfall	Weather	High	High

Interactions between PTW accidents and …

RIDER/DRIVER BEHAVIOR

LEADER: CEESAR

Rider/Driver Behavior – Analysis Framework



Rider/Driver Behavior – Macroscopic Analysis

- Prevailing PTW accident scenarios
  - Main accident configurations for the five countries (FR, GR, UK, FI, IT)
  - Common or not to the five countries involved
  - 20 PTW accident configurations

- Only 9 accident scenarios for in-depth analysis
  - E.g. single moped/motorcycle accidents inside/outside urban area, accidents with more than one vehicle involved

Rider/Driver Behavior – Microscopic Analysis

- Analysis framework:
  - Who is involved in such accidents?
  - Where did the accidents occur and which type of vehicles were involved?
  - How the accidents evolved (from pre-crash to crash and immediately after the crash)?
  - When did the rider or the driver fail? → What is the degree of influence of an accident factor?
  - What are the blunt end failures, the latent and sharp end ones?

Rider/Driver Behavior – Microscopic Analysis

- 4 different models (conceptual approaches)
- Each model
  - Has a different approach to the understanding and classification of the causation factors
  - Acts complementary to provide an overall summary of causation factors.
- Comparative study of the results

Rider/Driver Behavior – Critical Factors

- Perception of drivers/riders and human errors
  - Failure in perceiving the PTW by another vehicle driver
  - Loss of control when experiencing direction choice problems
  - 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

Rider/Driver Behavior – Critical Factors

- In accidents involving mopeds
  - Licensing and riding experience
  - Type of activities
  - Protective PTW clothes
  - Errors
    - Moped rider often incorrectly positioned on the road or he/she voluntary takes risks.
    - The passenger car driver fails to look, he looks but does not see.
  - Night Riding

Rider/Driver Behavior – Critical Factors

- In accidents involving motorcycles
  - Frequency of riding
  - Daylight and alignment (curvature or not)
  - Area type
  - Errors
    - for single motorcycle accidents, a poor/loss of control because of excessive or non adapted speeds, risk taking, etc.
    - lack of perception (from the passenger car driver and of the motorcyclists)

Interactions between PTW accidents and …

ROAD INFRASTRUCTURE

LEADER: AIT

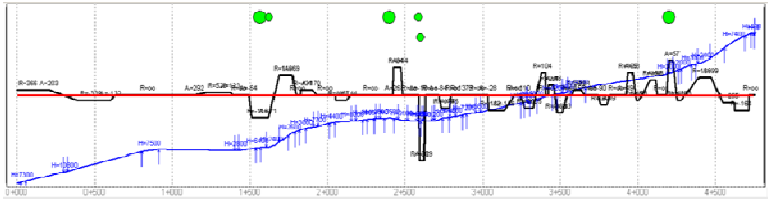
Road Infrastructure – Macroscopic analysis

- 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”

- Critical Factors
  - Area type
    - Increased number of PTW accidents inside urban areas and at intersections
    - Increased severity outside urban areas
    - Outside urban areas the most frequent is run-off road accident
  - Curves and descending gradients (GR)
  - Roundabouts (GB)
    - Less front to side accidents at roundabouts (ES)
  - Pavement conditions
    - Accidents on wet and slippery roads are less severe than on dry roads (IT)

- Methodology
  - In-depth accident data analysis (CIDAUT)
    - Analysed and reconstructed accident data from a special investigation team
    - 67 motorcycle accidents (2003-2009)
  - Linkage of crash data, road geometry data and road surface data using special measurement vehicle and software tools (BASt, AIT)
    - Crash data of injury motorcycle driving (IMD) accidents outside urban areas (2002-2006) and
      measurement data on road geometry (2009)
    - Austrian PTW accident data and infrastructure data (2000-2007)

- Critical Risk factors
  - Negative 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 100ma
  - Unbalanced ratio of successive radii
  - Curvature change rate [gon/km]



- Critical Risk factors
  - Deficits
    - Longitudinal or transversal unevenness have significant impact
    - Continuous deficits concerning the skid resistance have no impact
    - Rut depth and texture seem to have a low impact
  - Barriers
  - Roundabouts

Road Infrastructure – Microscopic analysis

RECOMMENDATIONS

- Safe/forgiving roadside or protection from obstacle with motorcycle friendly protective devices

- Road surface improvements

- Improvement of conspicuity at roundabouts outside urban areas (e.g. electric lighting, retro reflecting materials)
- PTW safety as part of Road Safety Audit, Inspection and Impact Assessment (RSA, RSI, RSIA)

Interactions between PTW accidents and …

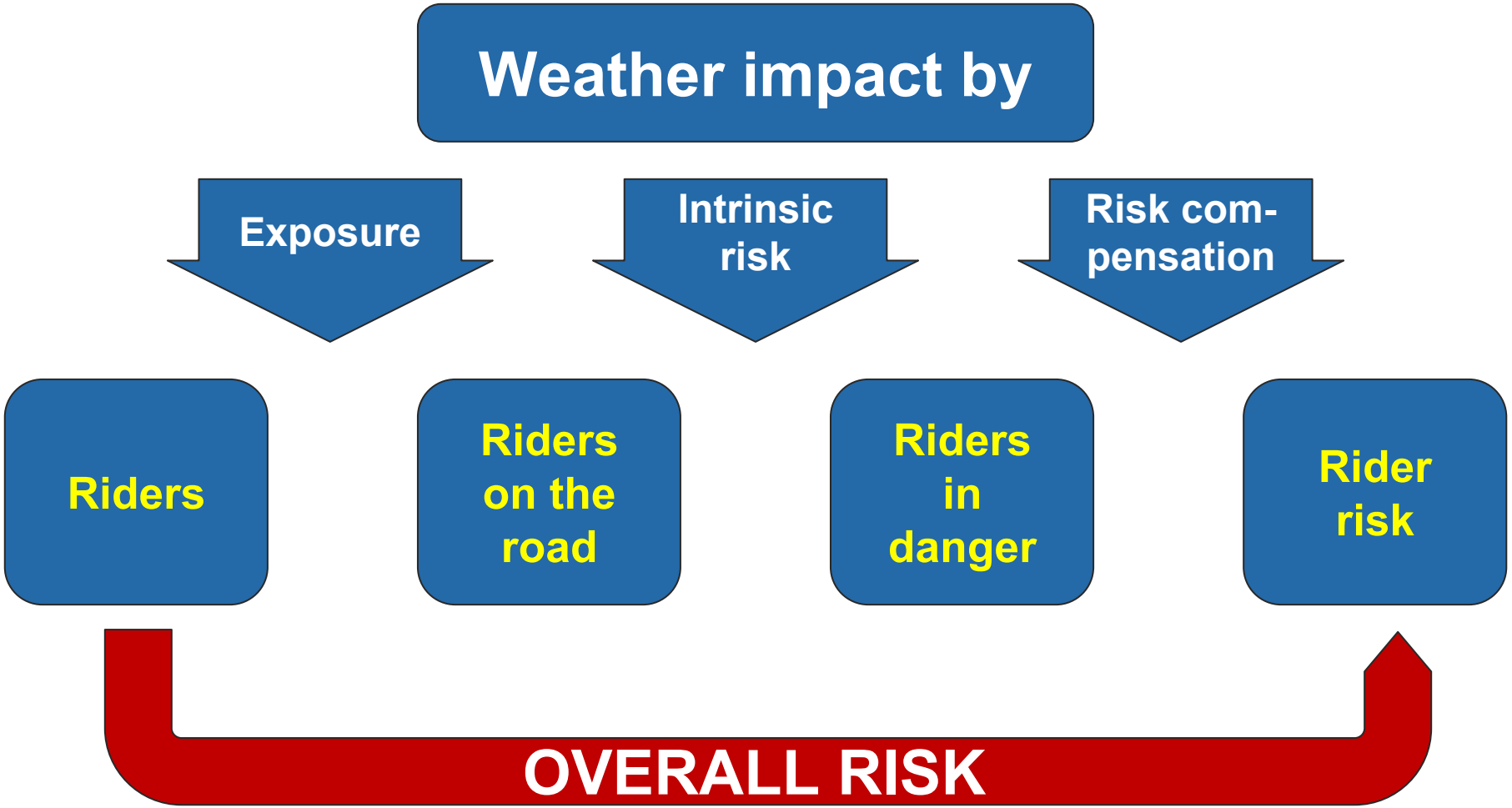
WEATHER CONDITIONS

LEADER: KfV

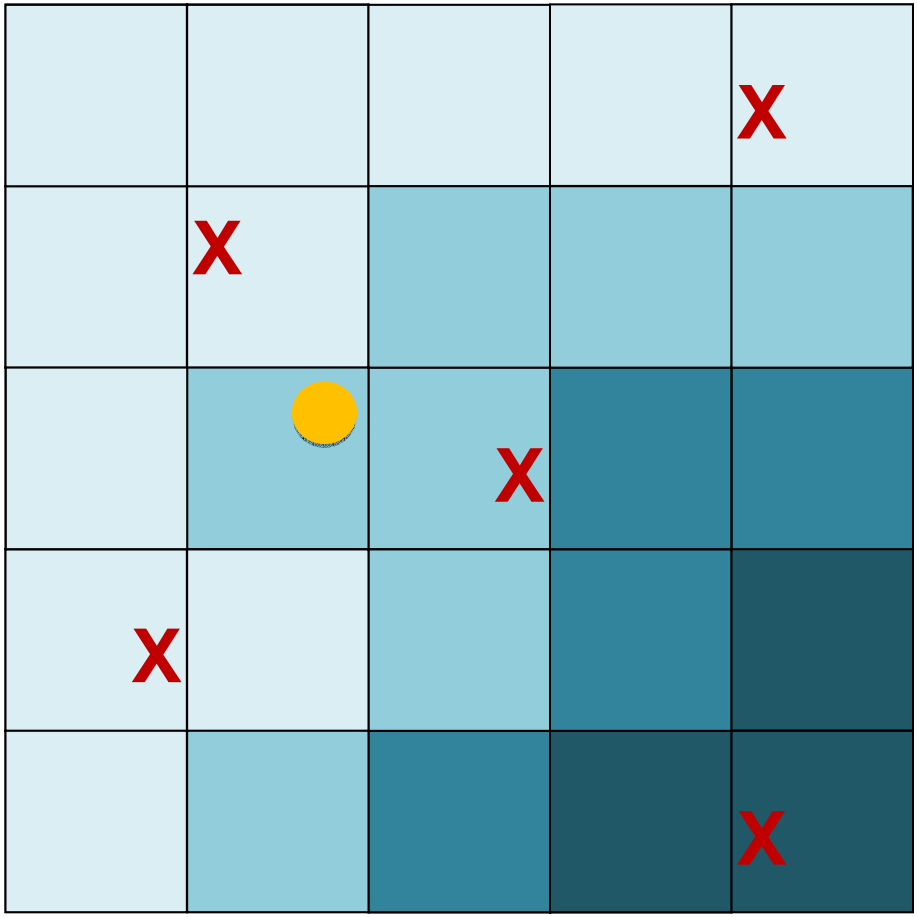
Weather Conditions - Methodology

- Problem:
  - Accident statistics biased by weather conditions
- Literature:
  - Hardly anything controlled for exposure
  - Nothing about PTWs
- Macroscopic Analysis:
  - Executed, but with limited results

Weather Conditions - Methodology



Weather Conditions – Methodology & Data

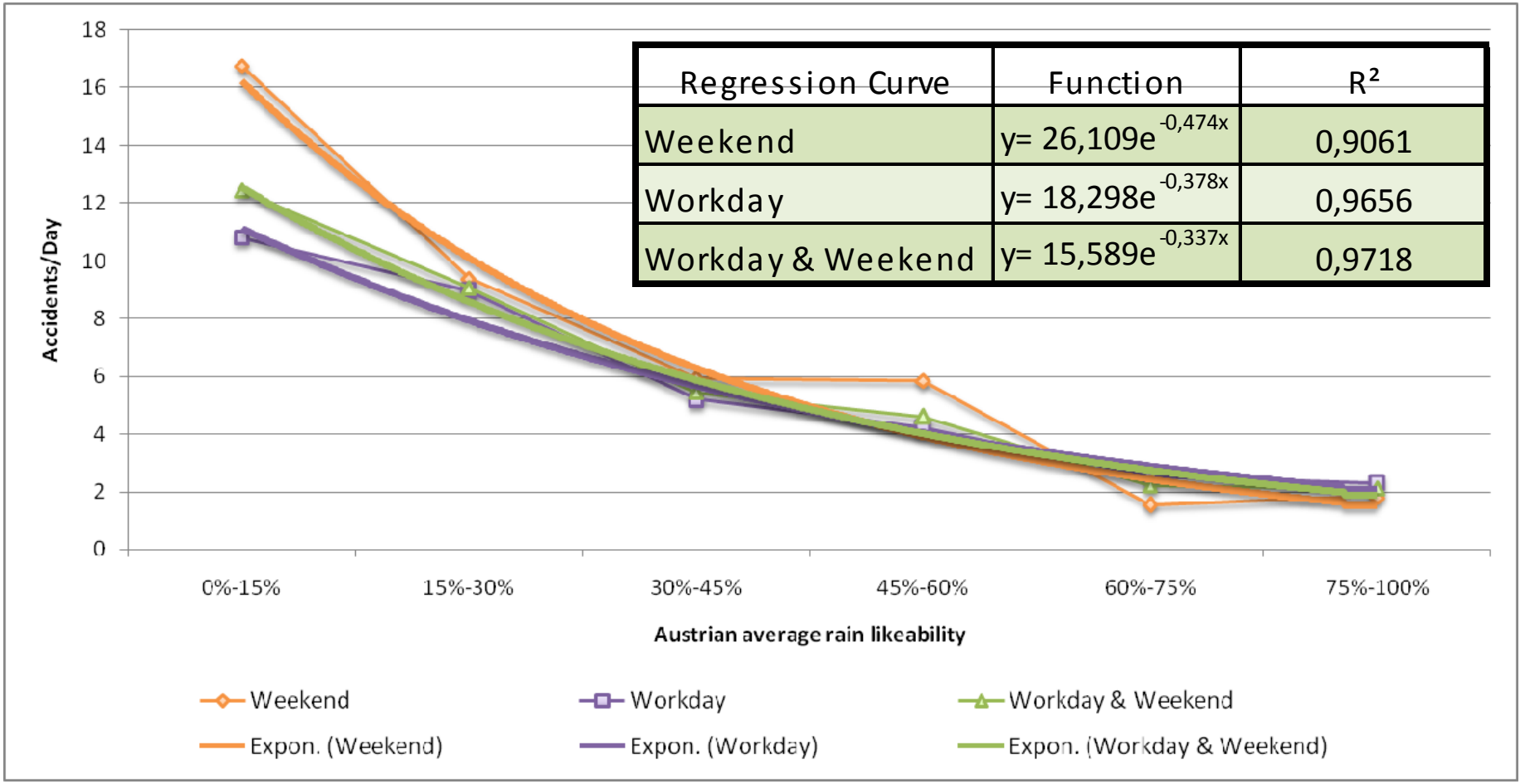


X…. Weather Station

… Accident

"VERA" (vienna enhanced resolution analysis) model
Institute for Meteorology and Geodynamics
University of Vienna

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 - Findings

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**

- Weather effect on road accidents was found significant
- However, exposure data are needed for a more complete and accurate analysis

Weather Conditions - Findings

- Correlation of Weather and Collisions
  - On sunny weekends, 8 times more motorcycle collisions occur than on rainy weekend days
  - On sunny workdays, 5 times more motorcycle collisions occur than on rainy workdays

However, detailed exposure data (traffic volume, composition, speed) should be co-considered before valid conclusions can be drawn.

Concluding Remarks

- PTW Accident Factors from three different aspects
  - Ride/Driver
  - Road Infrastructure
  - Weather Conditions
- Interactions were revealed based on both macroscopic and in-depth analyses

Concluding Remarks

- Issues of interest
  - Study the accident configurations rather than entire accident datasets.
  - Some accident scenarios are more relevant regarding accident frequency and/or accident severity.
  - Acquire complete accident data in a homogeneous format (across countries)

- Limitations
  - Few data available from PTW in-depth studies
  - Lack of exposure data
    - systematic data collection (pan-European studies)
    - reliable data collection procedure
    - sufficiently dissagregated
    - comparable with other traffic data

Power Two Wheeler critical risk factors Behaviour - Infrastructure - Weather

John Golias, George Yannis, Eleni Vlahogianni, NTUA
Phan Vuthy, CEESAR - Peter Saleh, AIT – Martin Winkelbauer, KfV