



# Simone Piantini

## Studio approfondito degli incidenti stradali gravi nell'area metropolitana fiorentina: il progetto RASIF

### Università degli Studi di Firenze

Dipartimento di Meccanica e Tecnologie Industriali

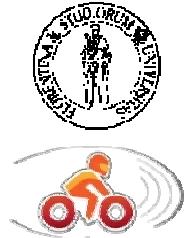


Research Centre for Innovation and Safety of  
**Powered2Wheeler**



Progetti Europei e Ricerca sulla Sicurezza Stradale: trasferibilità delle buone pratiche nel contesto Italiano  
27 Novembre 2012, Roma

# Summary



## 1 The RASIF project

- 1.1 Aims of the research
- 1.2 Workgroup
- 1.3 Workflow

## 2 The In-SAFE database

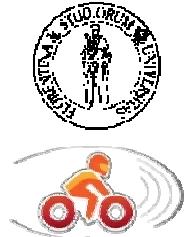
- 2.1 Crash information
- 2.2 Medical information
- 2.3 3D localization of the injuries

## 3 In-depth accident investigation

- 3.1 Example of case study

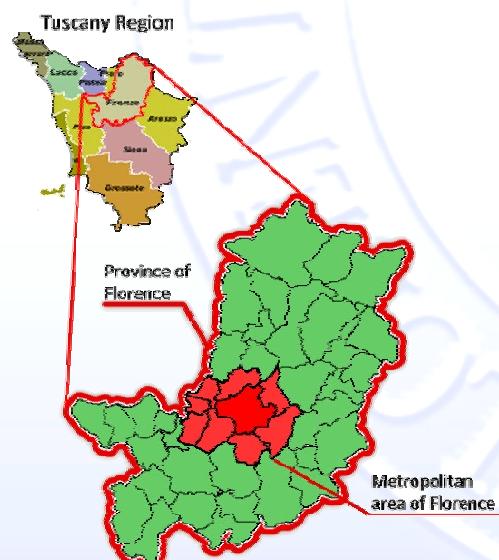
## 4 Results

# The RASIF project



## Road Accident Serious Injuries in Florence

Metropolitan area of Florence



Serious road accidents

Major trauma  
ISS > 15

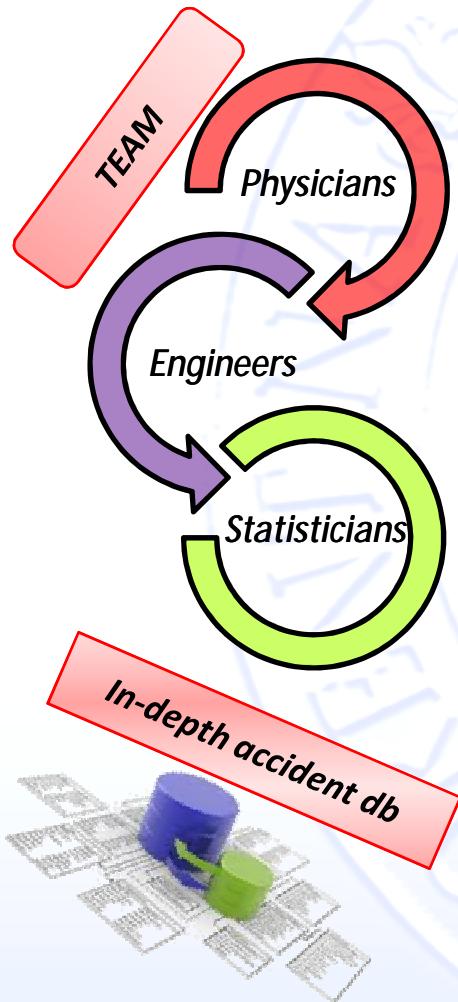
Duration: 3 years  
2012-2014

Total cost  
192.000 €

EU financing  
96.000 € (50%)



# Aims of the research



- 1 *Identification of the body parts most frequently injured for the different road users type, .... etc.*
- 2 *Estimation of the dynamic crash parameters*
- 3 *Assessment of the acceleration value for every body part*
- 4 *Highlight the main impacted objects*
- 5 *Assessment of the social costs and disabilities*

# Workgroup



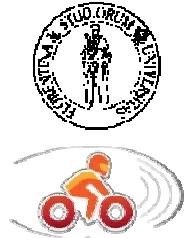
Department of Mechanics and Industrial  
Technologies (DMTI)  
at the University of Florence



Anaesthesia and Intensive Care Unit  
at the Emergency Department of the  
Careggi University Hospital of Florence



# Workflow



*Accident circumstances  
from the police force and  
inspections*

*Medical information*

*Causation of accident scenarios  
with Driving Reliability and Error  
Analysis Method - DREAM*

*In-depth*

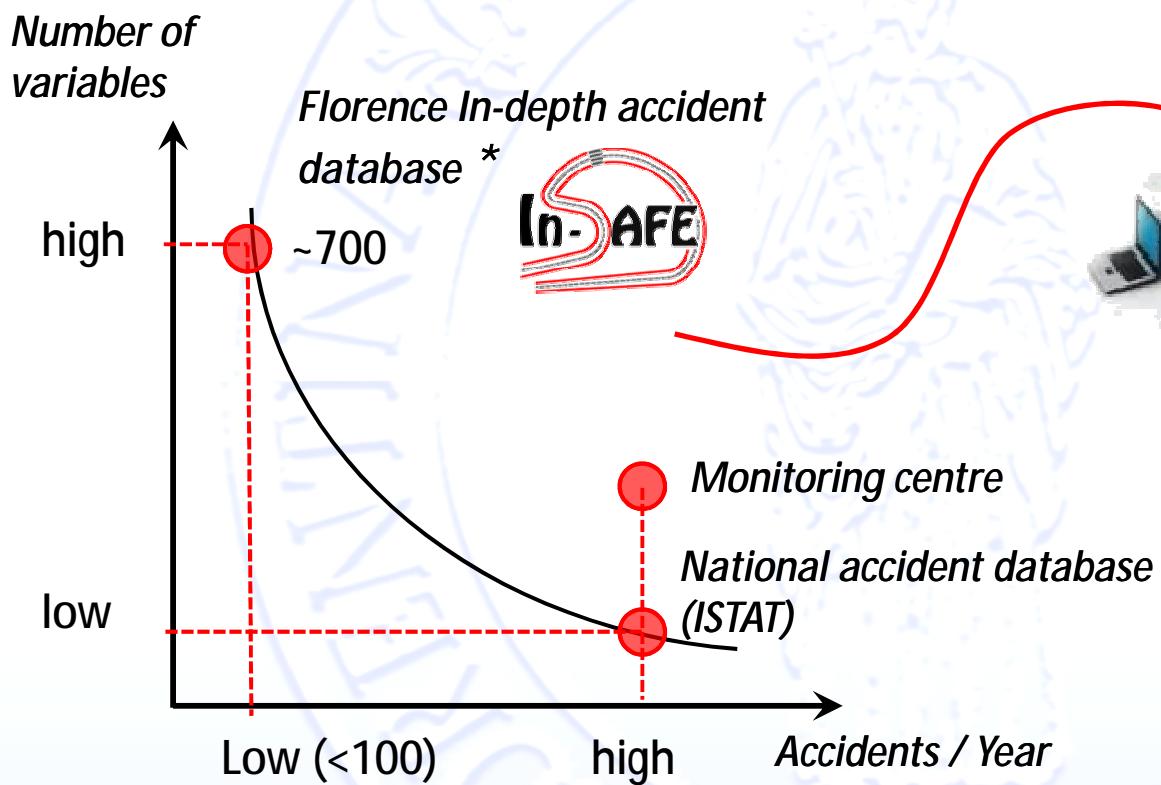
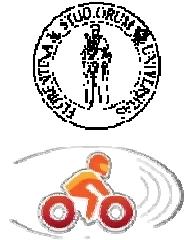
*Vehicle information  
from the police force and our  
inspections*

*Accident reconstruction  
by analytical formulation and  
specific software*

*Injury correlation*

*In-SAFE database*

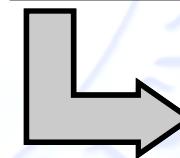
# The In-SAFE database



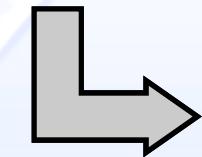
*In-SAFE database*



MySQL  
language



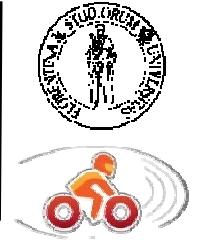
Web based  
technologies  
(XAMPP)



Access  
protected

\* Based on the OECD protocol (for the PTW) and STAIRS protocol

# The In-SAFE database



## ***Accident circumstances***

- § Date
- § Nature of the accident
- § GPS localization
- § Road description
- § Weather description
- § Visibility description
- § Imagines

## ***Vehicles***

- § Technical information
- § Safety devices
  - seatbelts, airbags, ABS, ESP ...
- § Pre-impact phase data
- § Impact phase data
- § Post-impact phase data
- § Infringements

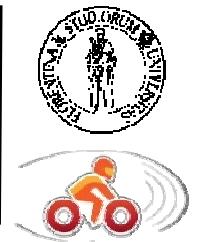
## ***People***

- § Personal data
- § License type
- § Seatbelts
  - type, use, activation
- § Helmets
  - type, use, damage location
- § Type of clothing
- § Pre-impact phase data
- § Impact phase data
- § Post-impact phase
- § Injury correlation

## ***Medical Information***

- § Emergency Medical Service (EMS)
- § Emergency Room (ER)
- § Intensive Care Unit

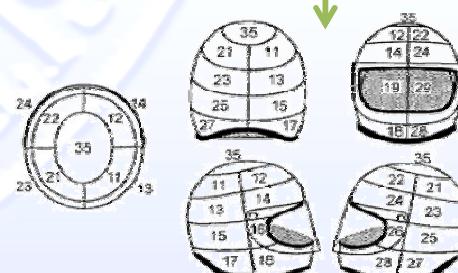
# Crash information



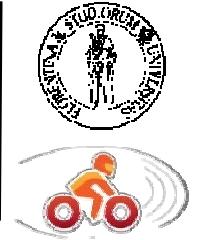
Vehicles
Pre-crash phase
<ul style="list-style-type: none"> <li>§ Actions (prior and after precipitating event)</li> <li>§ Avoidance manoeuvre (after p. e.)</li> <li>§ Speed</li> <li>§ Line of sight (driver)</li> </ul>
Crash phase
<ul style="list-style-type: none"> <li>§ Status of Seatbelts and Airbag</li> <li>§ Roll, yaw, pitch angle</li> <li>§ Impact angle</li> <li>§ Impact speed</li> <li>§ Delta-V</li> <li>§ PDOF</li> <li>§ EES</li> <li>§ Deformation energy absorbed</li> <li>§ Deformation (Crash3 measures)</li> <li>§ CDC (SAE j224)</li> </ul>
Post-crash phase
<ul style="list-style-type: none"> <li>§ Distance travelled (POI - POR)</li> </ul>

People
Pre-crash phase
<ul style="list-style-type: none"> <li>§ Alcohol and Drug test</li> <li>§ Psychophysical condition</li> <li>§ Human factor</li> <li>§ View blocked</li> </ul>
Crash phase
<ul style="list-style-type: none"> <li>§ Car occupant <ul style="list-style-type: none"> <li>• Movement</li> <li>• Impacted object</li> </ul> </li> <li>§ Pedestrian <ul style="list-style-type: none"> <li>• Movement</li> <li>• Impacted object</li> <li>• Point of rest</li> <li>• Trajectory</li> <li>• Rest position</li> <li>• Throw distance</li> </ul> </li> <li>§ Motorcyclists <ul style="list-style-type: none"> <li>• Helmet</li> <li>• Type of clothing</li> <li>• Movement after crash</li> <li>• Impacted object</li> <li>• Point of rest</li> <li>• Throw distance</li> </ul> </li> </ul>

- Use alcohol
  - Use drug
  - Over-driving
  - Fatigued
  - Stress
- 
- Forward
  - Backward
  - Lateral
  - Ejection
- 
- Type
  - Retention system
  - Type of conformity
  - Ejection
  - Damage



# Medical information



## ***Medical Information***

- § Emergency Medical Service (EMS)
- § Emergency Room (ER)
- § Intensive Care Unit (ICU)

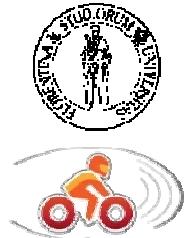
## ***ER & ICU***

- § *Comorbidities*
- § *Addictions*
- § *Treatments* (EMS / ER / ICU)
- § *Injury Score*
  - AIS, ISS, NISS, EMTRASS
- § *Follow-up*
  - follow-up at 6 month, mortality at 6 months, ICU Length Of Stay (ICU LOS) and in Hospital Length Of Stay (Hospital LOS), Glasgow Outcome Scale (GOS)

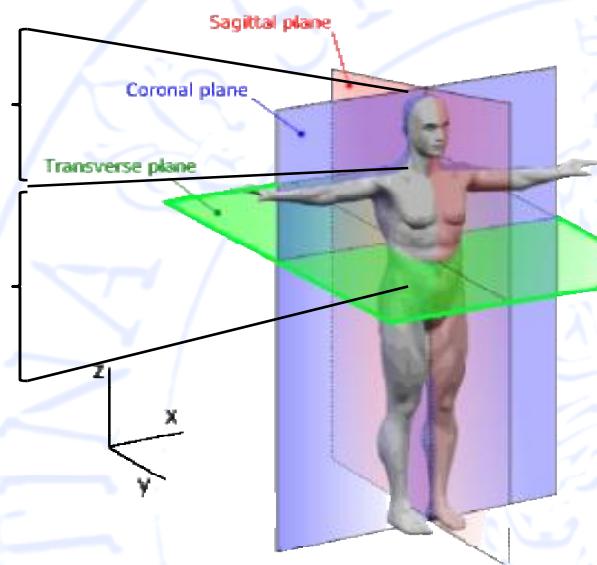
<b>Injury description</b>	<b>AIS code*</b>
Right tympanic and petrous fracture with hemotympanum	150202.3

\* AIS 2005, update 2008

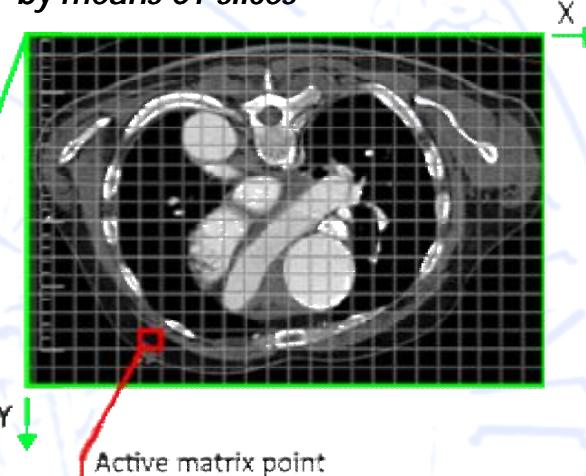
# 3D localization of the injuries



Head-face  
Neck  
11 slices  
Thorax  
Abdomen  
28 slices



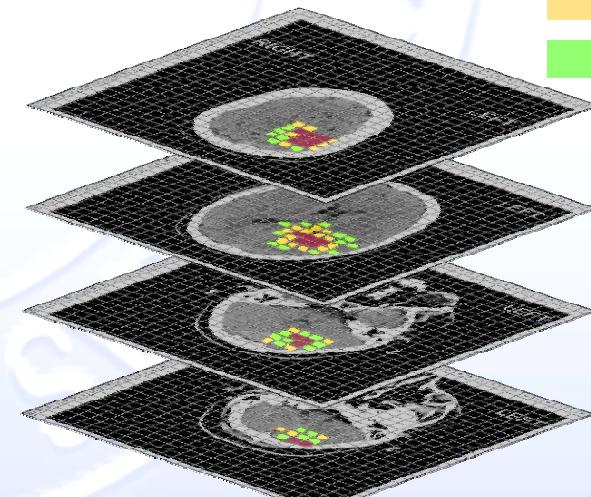
by means CT slices



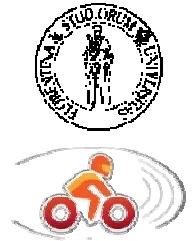
- AIS > 3
- AIS = 3
- AIS < 3

Matrix of pixel (5x5 mm)

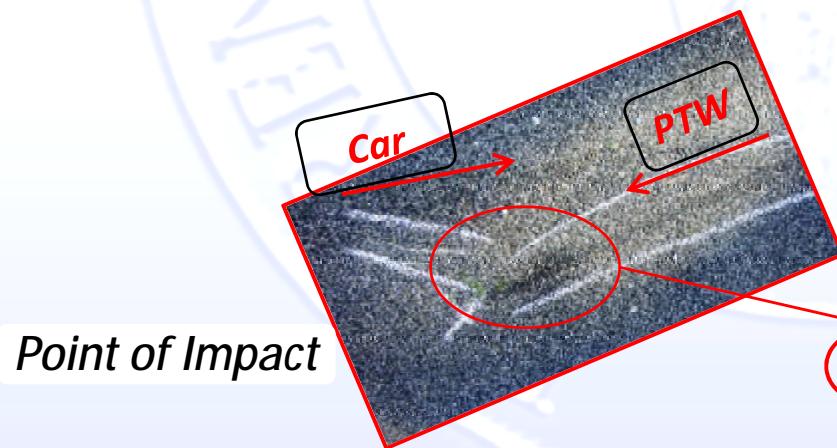
Slice	X	Y
1	A, A, A, B	3, 4, 5, 2
2	A, A, B, C	2, 3, 2, 4
3	B, C, D	3, 3, 3



# In-depth accident investigation



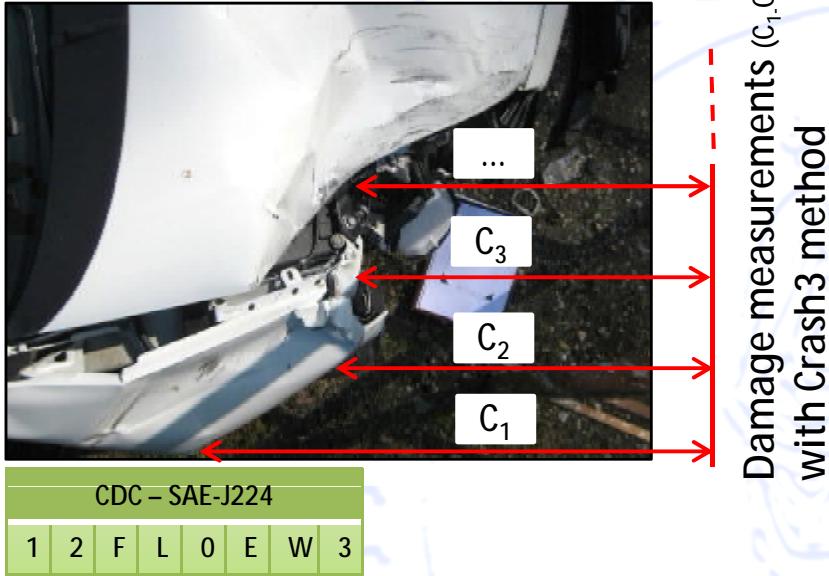
*Crash scene*



*Point of Impact*



# In-depth accident investigation



Against right A pillar



Motorcycle suit

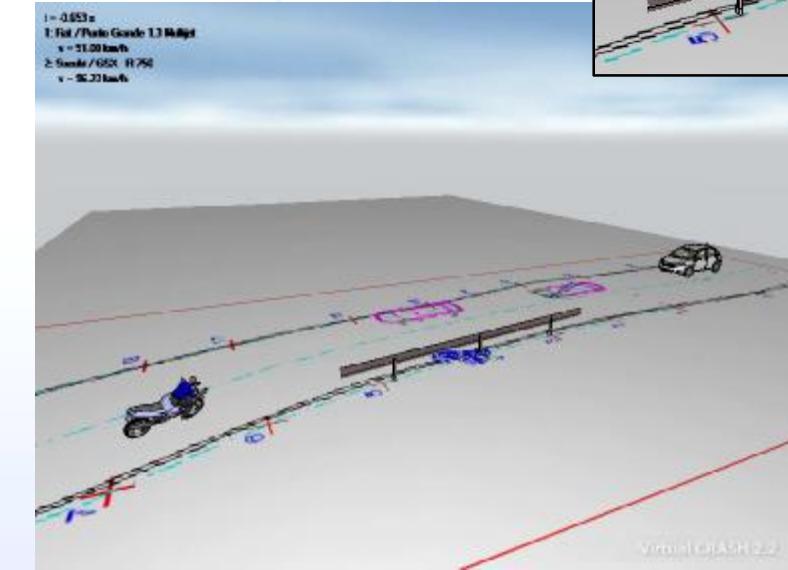
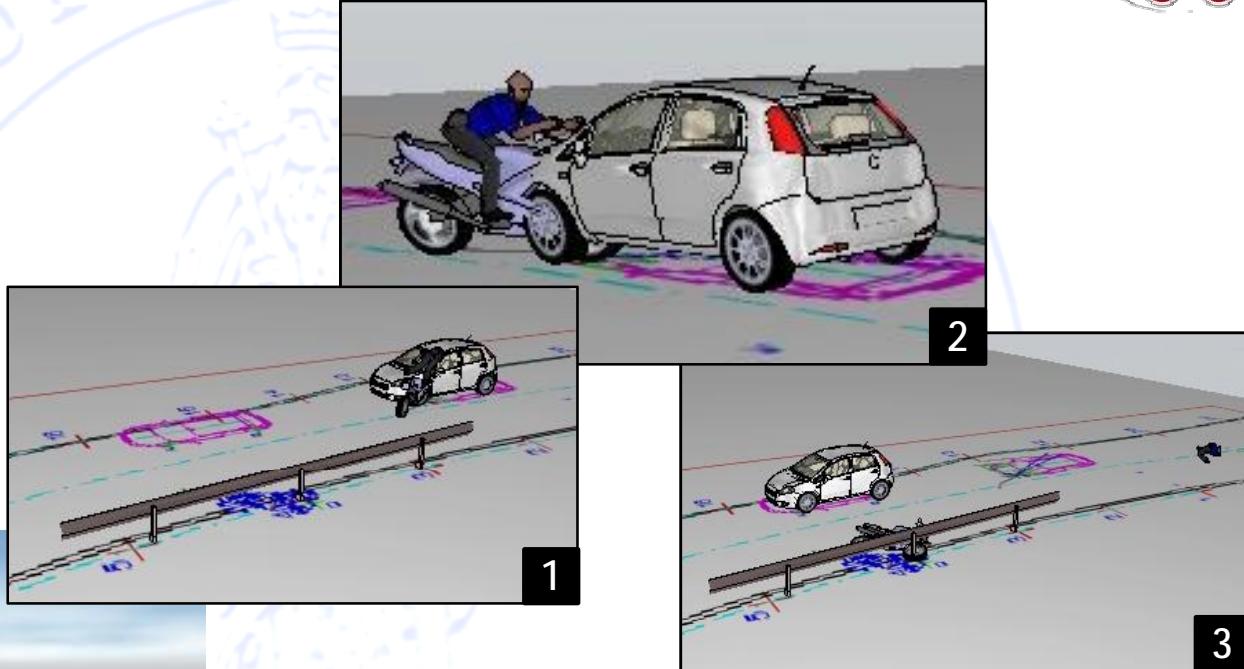
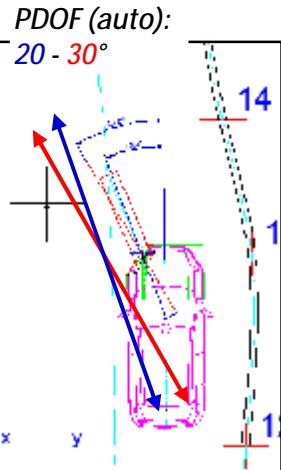
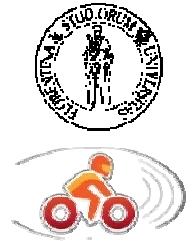


Seatbelts



Airbags

# In-depth accident investigation



Car

$V_{impact-car} = 55 \pm 3 \text{ km/h}$   
 $Braking_{car} = \text{yes}$   
 $\Delta V_{car} = 31 \text{ km/h}$   
 $PDOF_{car} = 11$

Motorcycle

$V_{impact-ptw} = 88 \pm 3 \text{ km/h}$   
 $Braking_{ptw} = \text{yes (wheel lock)}$   
 $\Delta V_{ptw} = 128 \text{ km/h}$   
 $PDOF_{ptw} = 12$

# In-depth accident investigation



Body region	Injury description	AIS	Impacted Object	Reliability $\beta$ [%]
Head	Blood cloth in the interpeduncular cistern	140678.2	A pillar	80
Thorax	VIII-IX-X-XI-XII right rib and the XII left rib fractures	450203.3	Asphalt	100
Lower extremity	Comminuted fracture of the proximal third of the right femoral shaft	853271.3	Fuel tank	90
Spine	D7-D8-D9-D10 left transverse processes fractures	650420.2	Asphalt	100
...	...	...	...	...



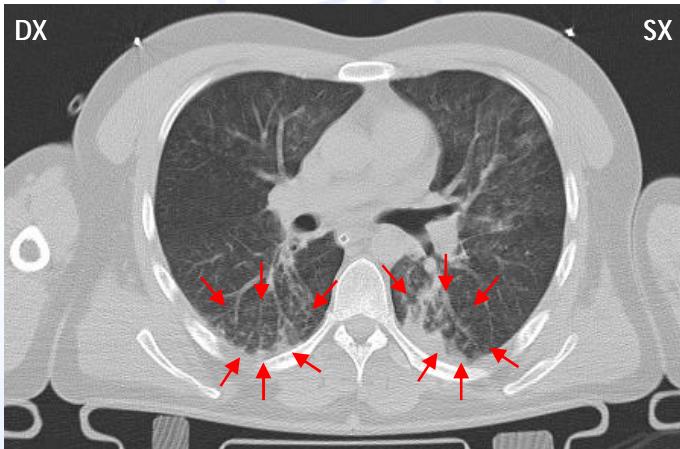
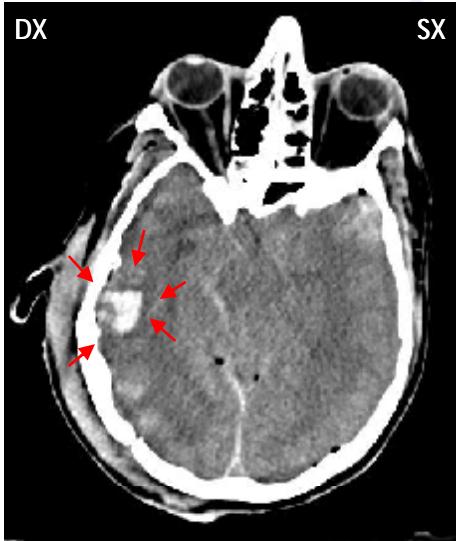
$$\beta = 1 - \alpha$$

*Uncertainty on the association.*

	MAIS
Head or Neck	2
Face	0
Thorax	4
Abdomen	2
Extremities	3
External	0
<b>ISS</b>	<b>34</b>

Threshold value equal to  
60%

# In-depth accident investigation



Injury: Right tympanic and petrous fracture with hemotympanum

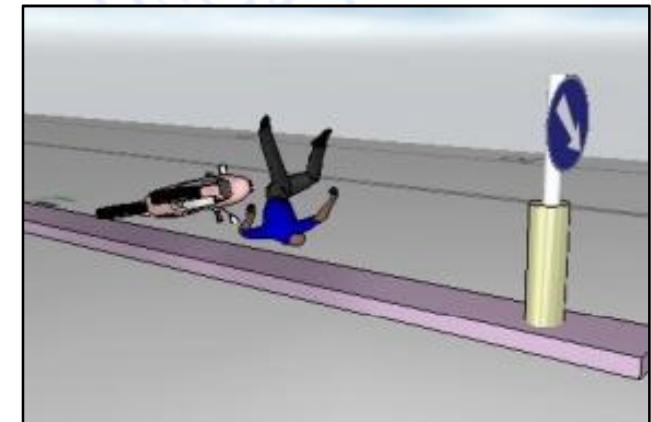
AIS: 150202.3

Impacted Object: Asphalt

Reliability: 90%



*Both injuries are due to the impact against the ground without helmet*



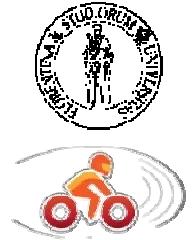
$$V_{impact-ptw} = 57 \pm 5 \text{ km/h}$$

Braking<sub>ptw</sub> = none

$$\Delta V_{ptw} = 8 \pm 3 \text{ km/h}$$

	MAIS
Head or Neck	4
Face	0
Thorax	4
Abdomen	0
Extremities	0
External	1
<b>ISS</b>	<b>33</b>

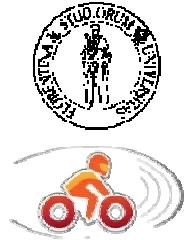
# In-depth accident investigation



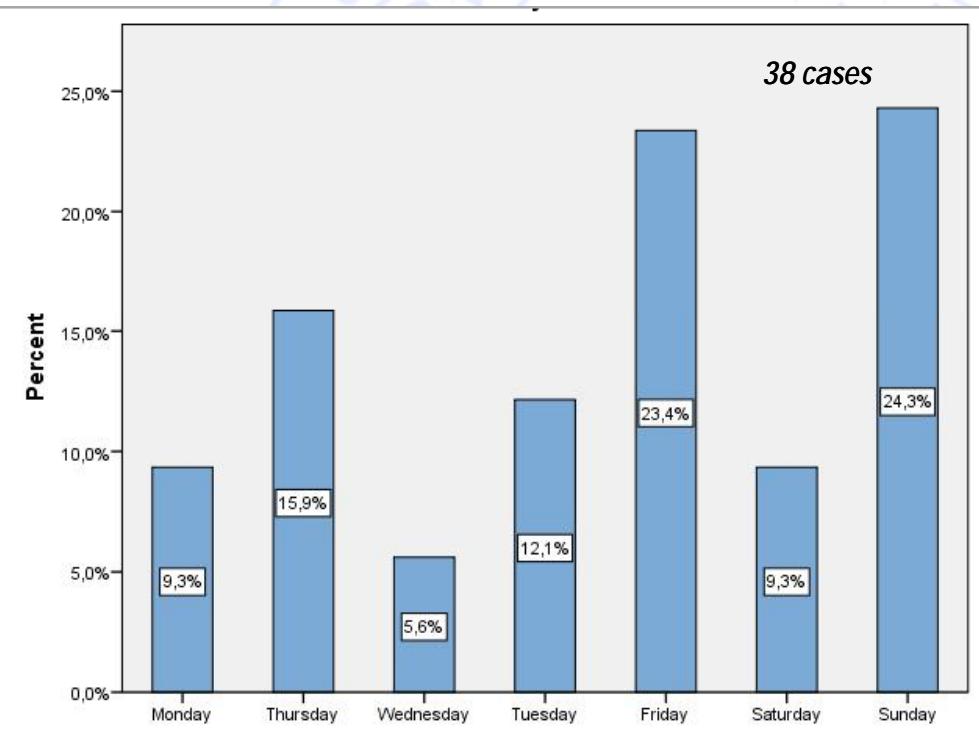
Capelli ➔ Urto testa  
Frattura vetro ➔ Lesioni alla testa

Urto bacino e  
gomito

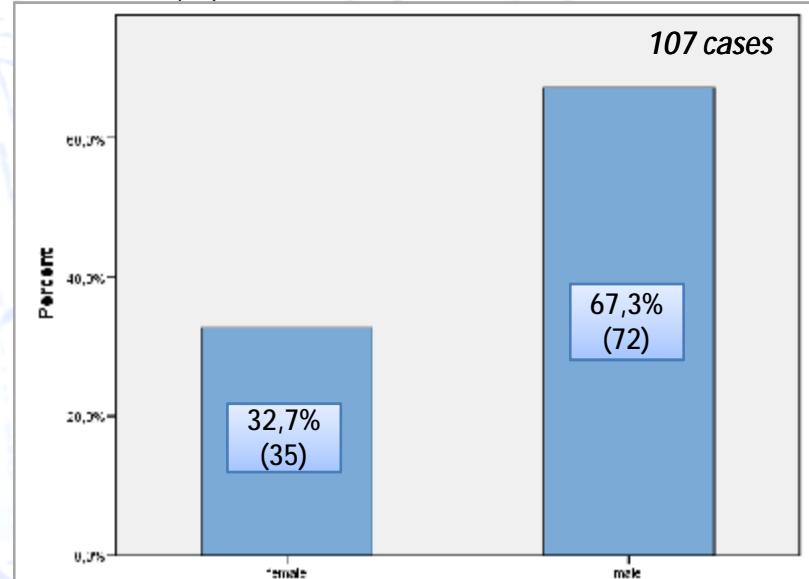
# Results



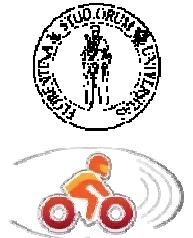
*Serious road accident for weekday (%)*



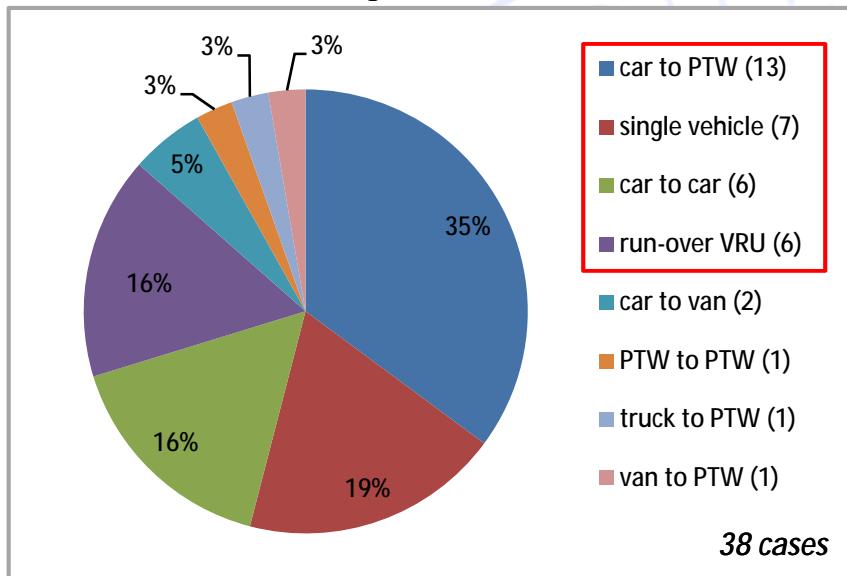
*Gender (%)*



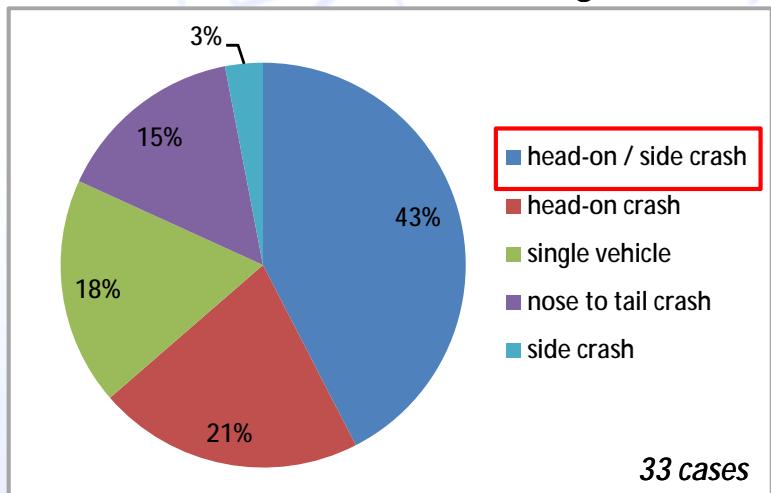
# Results



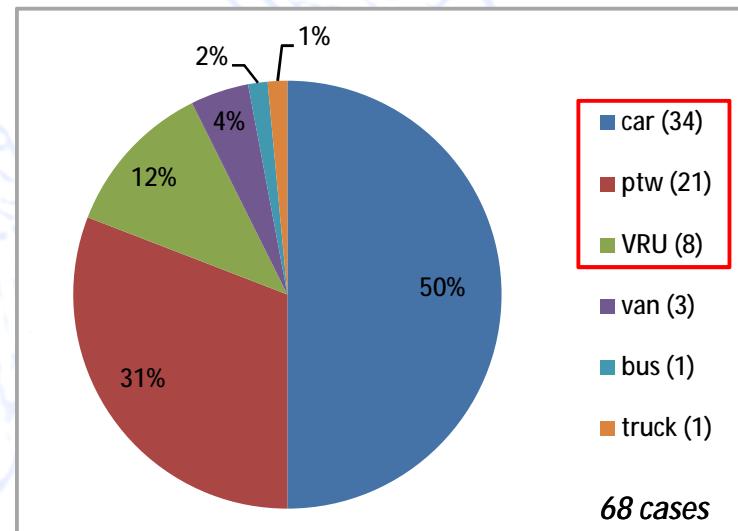
*Road accident configurations (%)*



*Vehicle-to-Vehicle collision configurations*



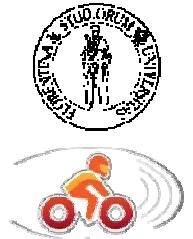
*Type of users involved (%)*



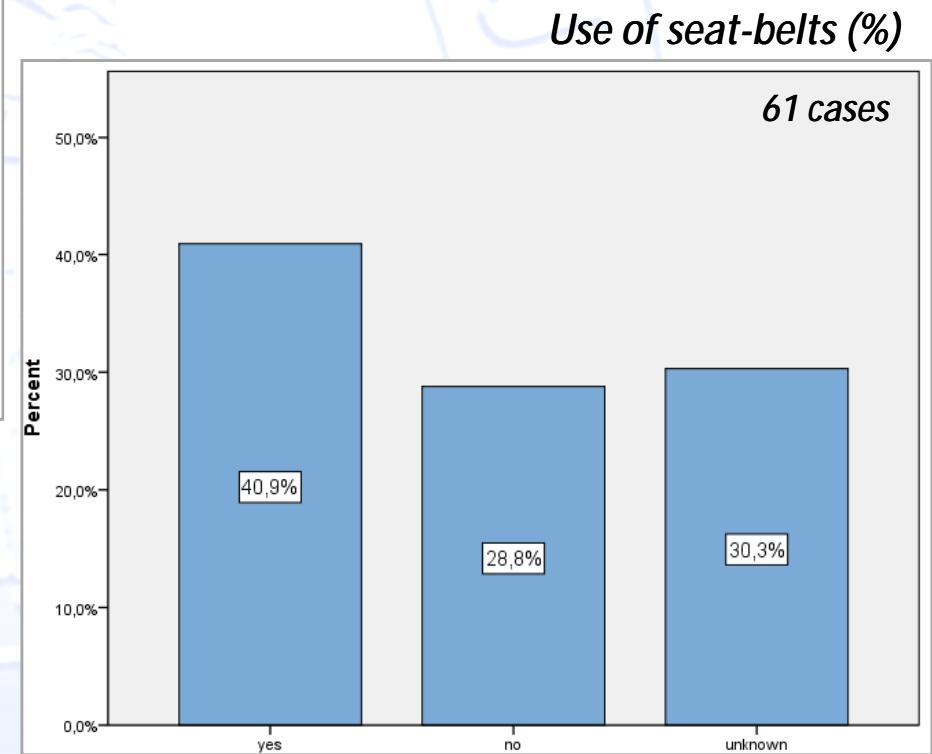
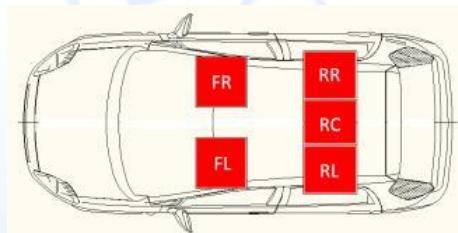
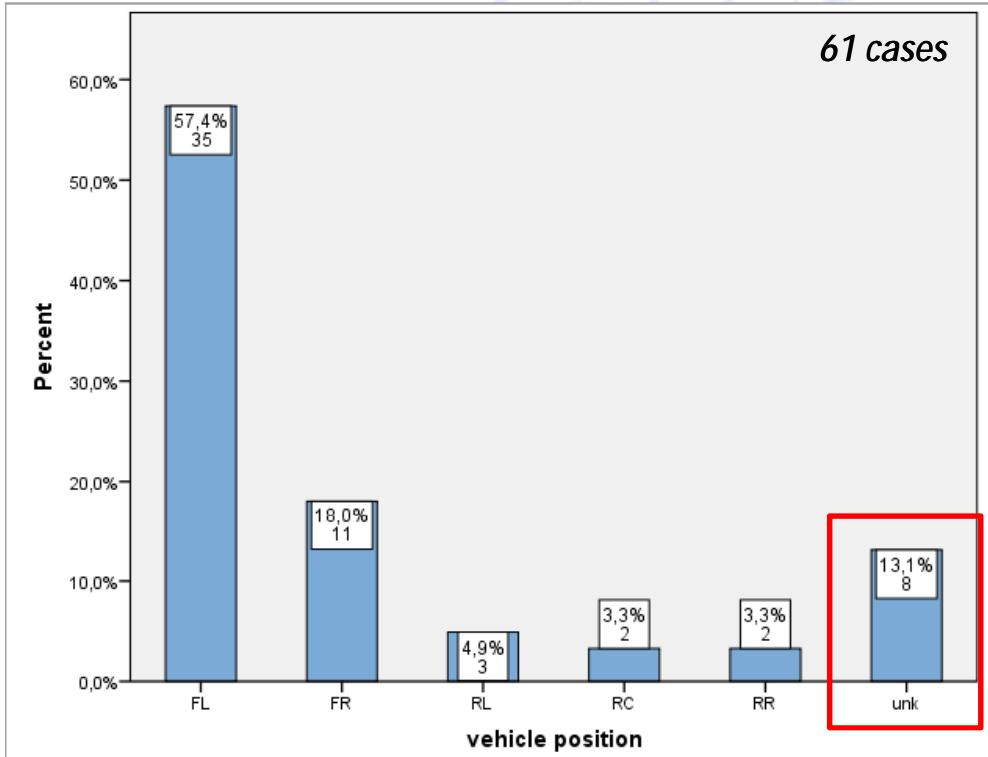
PTW

- 29% moped
- 71% motorcycle (>50cc)

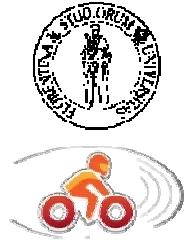
# Results



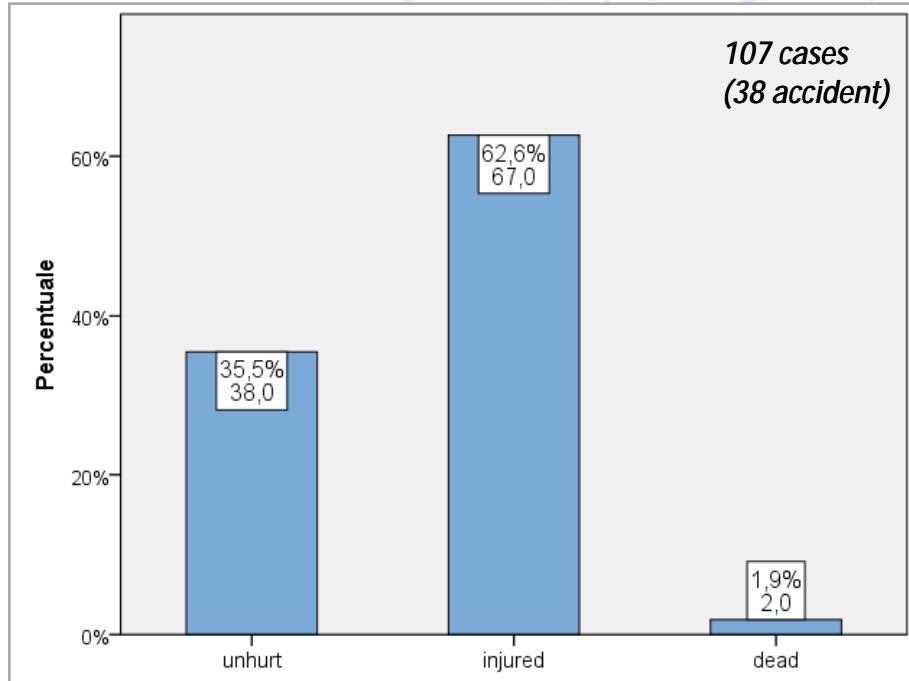
*Car occupant position (%)*



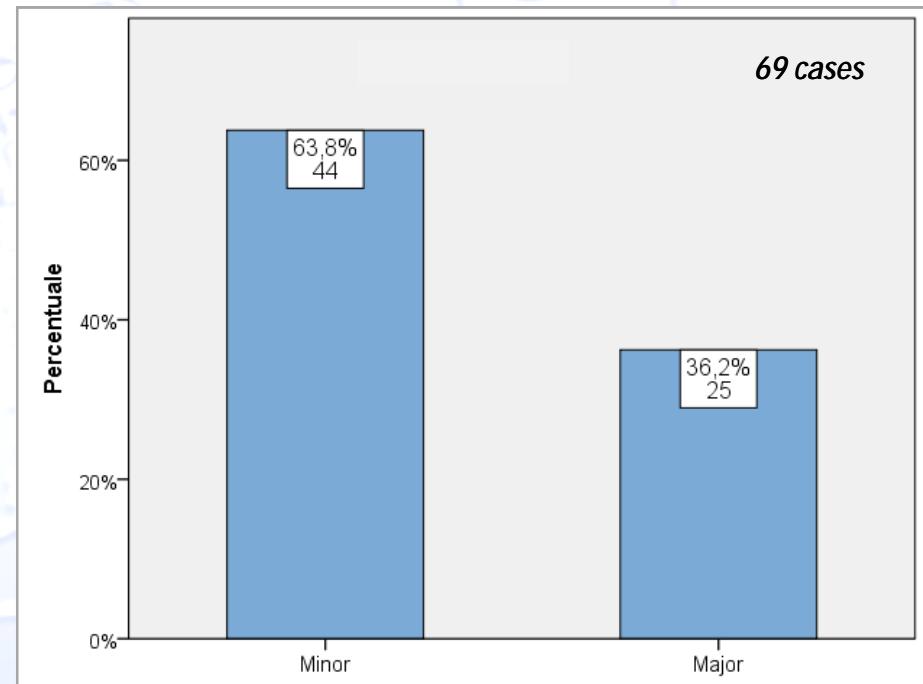
# Results



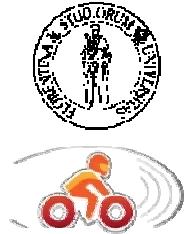
*Outcome (%)*



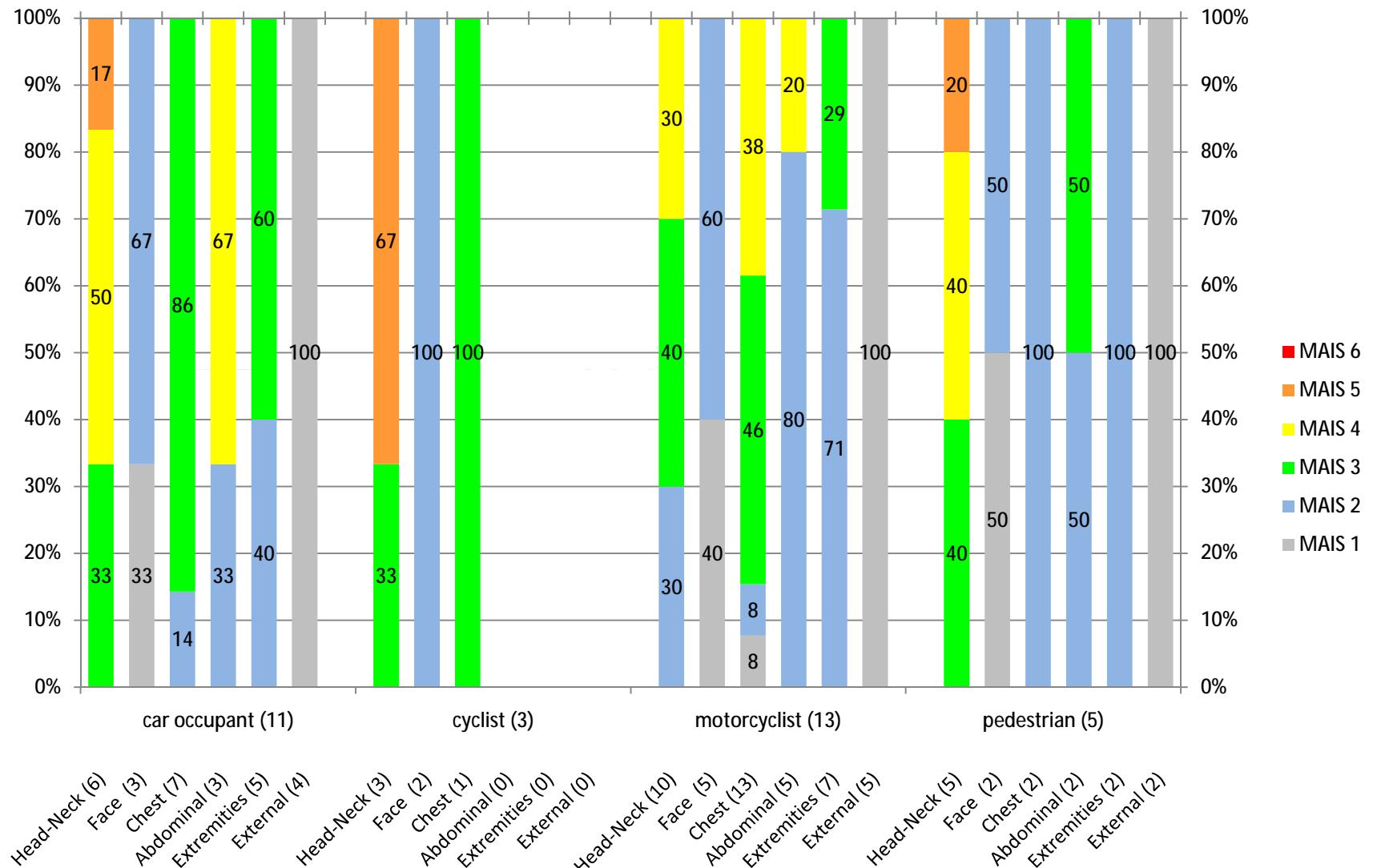
*Minor and Major trauma (%)*



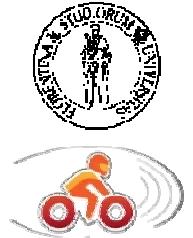
# Results



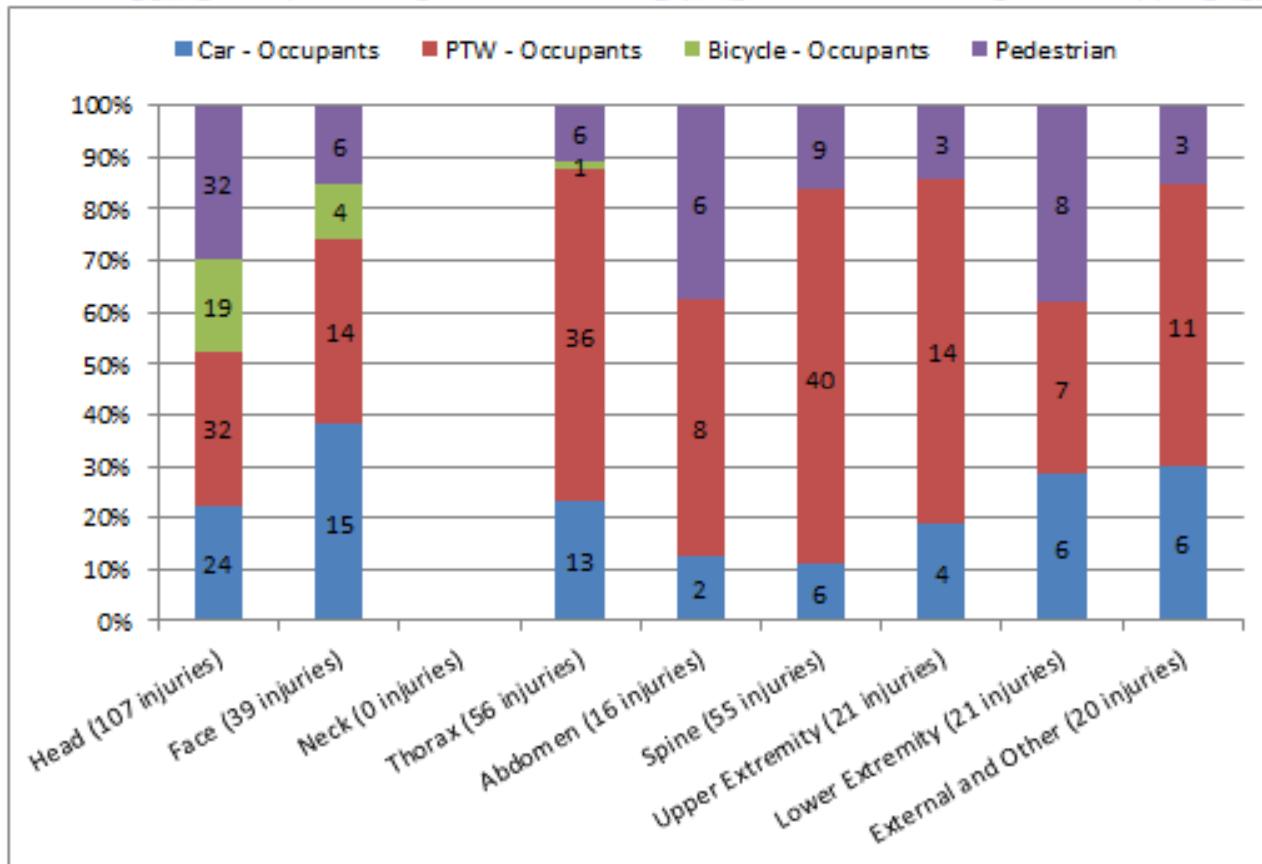
*Maximum-AIS (MAIS) for different types of road users (%)*



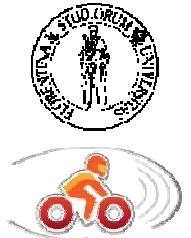
# Results



*Frequency of lesions by body part for a road users (%)*



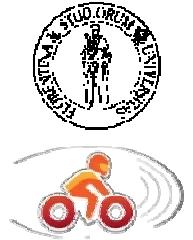
# Results



*Source of the head injuries in the Motorcyclists (%)*

	Impact object					Total
	Asphalt / pavement	Barrier / guard rail	Curb	Pole/ post	windshield header rail	
Base (basilar) fracture	2 25,0%	0 0,0%	0 0,0%	0 0,0%	6 75,0%	8 100,0%
Cerebrum	8 36,4%	3 13,6%	3 13,6%	4 18,2%	4 18,2%	22 100,0%
Vault fracture	2 100,0%	0 0,0%	0 0,0%	0 0,0%	0 0,0%	2 100,0%
Total	12 37,5%	3 9,4%	3 9,4%	4 12,5%	10 31,3%	32 100,0%

# Conclusions and future work



- q The RASIF project study the body injuries distribution for different type of road users, accident configuration and crash parameters
- q Evaluation of dynamic crash parameters
- q Assessment of the acceleration value for every body part
- q Study of disabilities and social cost due to serious accident
  
- q Create a stable/permanent collaboration between University, Hospitals and Police Forces
- q Consolidation of the data collection
  - q Analysis of the missing cases
  - q Real time collection

# Thank you for your attention!

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Website: [www.ptw.unifi.it](http://www.ptw.unifi.it)

Research Centre for Innovation and Safety of  
**Powered2Wheelers**

