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RASIF

Road Accident Serious Injuries in Florence

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PROJECT PERIODIC REPORT

Grant Agreement number: MOVE/C4/SUB/2011-294/SI2.625719

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Project title: Road Accident Serious Injuries in Florence

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1 Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

2 The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator

I, as scientific representative of the coordinator[1] of this project and in line with the obligations as stated in the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate)[3]:

  ☐ has fully achieved its objectives and technical goals for the period;

  X has achieved most of its objectives and technical goals for the period with relatively minor deviations;

  ☐ has failed to achieve critical objectives and/or is not at all on schedule.

- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations, have declared to have verified their legal status.

Name of scientific representative of the Coordinator[1]: Prof. Marco Pierini

Date: 08/06/2016

Signature of scientific representative of the Coordinator[1]: .....

[3] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

Publishable summary

Project context and main objectives

In 2012 road deaths of the EU27 experienced an average reduction of 9% (2.661 casualties) compared to the previous year and produced a savings of 5 billion Euro according to ETSC estimates, but this is not sufficient. In 2012, 1.078.746 road accidents occurred that caused 1.340.000 injuries, of which 313.000 people were seriously injured and 27.700 killed.

Of the 27.700 people killed, 21% were pedestrians, 7% cyclists and 18% motorcyclists. About 45% of road deaths are the so-called vulnerable road users.

In the high-income countries the urban areas represent the most dangerous environment for the vulnerable road users: almost half of all road deaths that occurred in these areas were pedestrians or cyclists. This was also confirmed by Siim Kallas, Vice-President of the EU Commission, who said: ''Pedestrians and cyclists are facing the biggest risks in urban areas. And these risks are likely to increase rather than decrease with ever rising traffic volumes in our growing cities''.

Modern urban traffic is a complex, rapidly changing and dynamic system, where the task of the driver has gradually become more and more complicated.

For this reason it is crucial to obtain answers to how and why accidents occur to develop efficacious policy countermeasures and active safety systems to prevent road accidents. It is also essential to find the answers to how and why the injuries occurred, to understand the typology and severity of the injuries due to real-world accidents and to evaluate the impact of the new active and passive safety systems.

Accordingly, it is vitally important to have complete and detailed data on injuries as well as the link between police and hospital databases. While this connection is well known, it is not as satisfactorily widespread in Europe as it is in the US. Previous EU projects (STAIRS, MAIDS, SafetyNet, DaCoTA) have built the foundation for the development of a common EU methodology of gathering road accident data, especially on an in-depth level.

At the end of 2010 the EU Commission established new safety targets for the decade 2011-2020. One of the objectives is to halve the number of road deaths compared to 2010. Another ambitious goal is to establish a road injury reduction target. For this purpose, the EU objective is to:

establish a common definition of serious and minor injuries;

establish a common EU-wide injury target to integrate into the 2010-2020 road safety guidelines;

promote the exchange of best practices for emergency service response to accidents;

promote a wide collection of data and an analysis of injuries.

These objectives highlight that the in-depth studies of road accidents, especially those which have caused serious injuries, are very crucial aspects for improving road safety. In detail, the understanding of which injuries are produced by specific accidents or impacts, as well as which injury mechanisms have generated those injuries and the consequent disabilities are essential components.

The RASIF study will build a new in-depth investigation team and the relative database on road accidents, studying the dynamics of the events, the causation factors, the injury typologies, the severities and the

disabilities. The study will also be focused on the impact that the injuries have on the quality of life of injured people both in the short and in the long terms.

In this way the RASIF project will support the diffusion of the in-depth road accident investigation methodology through the Europe and more in particular in the southern, where the investigation team are less spread compared to the northern Europe.

RASIF project will contribute to a better gain knowledge on the traffic injuries, and more in particular on the Vulnerable Road Users injured in the metropolitan traffic environment. The overall objectives of the project are:

- to gather the road accidents with seriously injured people principally occurred in the urban area;
- improving the knowledge of the injuries following by the serious road accidents and their mechanism of injuries;
- understand how the vehicle design evolution influences the body injuries;
- improvement of new medical procedures for the management of road traumas.

Description of work and main results achieved

The RASIF project started with a review of projects on road accident investigation and the relative in-depth database. In this phase a review of the state-of-the-art on the principally EU and US programmes was able to understand and make uniform the in-depth investigation techniques and the relative database structures. Following to this first step a deep-dive into the road traffic injuries have also been done. Due to the high number of Vulnerable Road Users (VRU), i.e. motorcyclists, cyclists and pedestrians, involved in the urban traffic accidents, a specific focus on this type of road users was carried out.

With the previous work and after having revised the state-of-the-art of EU and US in-depth databases, as well as the EU research programmes, an in-depth road accident database (named InSAFE) was built in order to store the data gathered. In order to simplify the usability and the exchange of the data gathered, the database has been developed following the guidelines establish by the DACOTA project.

In the project period the InSAFE team have collected 170 serious road accidents, of those, 90 cases were thoroughly investigated. We define serious accident an accident where at least one people involved in the crash was admitted to the intensive care unit (ICU). The investigation process starts with a retrospective inspection of the accident scene and, if it is possible, the inspection of the vehicles involved in the crash. After that, we proceed with the acquisition of the police documents and hospital data, especially the injuries. All the injuries suffered by the victims are codified by the abbreviated injury scale (AIS) and stored into the database in conjunction with the data coming from the accident reconstruction activities. Any case finishes with the correlation between injuries and causes.

Final results

Throughout a period of three years (2012-2015) the RASIF project has gathered 170 serious real-world road accidents. All these road accidents have occurred in metropolitan areas. 90 out of 170 cases have been fully investigated and studied.

In the sample of 90 road accidents there are three main different subsets: one involving powered-two wheelers (PTW) and other vehicles (OVs), one involving cyclists and OVs and the last one involving pedestrians and OVs. More specifically, 40 out of 90 crashes were PTW-to-OV crashes, 30 out of 90 were pedestrian-to-OVs crashes and 15 out of 90 were cyclists-to OV crashes.

The main results coming from these three subsets are the following:

- The most frequent serious urban PTW-to-OV crash configuration was the head-on side (45%, 18/40).
- The majority of urban PTW-to-OV accidents (57.5%, 23/40) happened far from intersections, but the intersections are still more dangerous than the previous one.
- The main pre-crash cause is OV performing a U-turn, or left/right turn manoeuvres in front of the PTW.
- This result points out the need for motorcyclists to monitor the surrounding environment and to anticipate other road users' manoeuvres. PTW active systems seem to have the potentiality to avoid or mitigate crashes following by the previous conditions.
- The PTW sample, both motorcycles that scooters, showed a high frequency (22.5%, 9/40) of wheel locking before the impact, which resulted in an early PTW loss of control.
- These events were mainly correlated to the absence of ABS systems in all the PTW sample object of the study. And those underline the importance of using such systems on all PTWs. As well as the importance in the quality performance of the braking manoeuvre. In an emergency phase, in order to avoid the PTW loss of control, an improvement in the quality of the braking manoeuvre can help to avoid the PTW loss of control.
- Large cars seem to have a greater influence on injuries than the small and compact ones.
- Despite all motorcyclists seriously injured were wearing a helmet during the crash, the head still needs for a more adequate protection level. Approximately 40% of the sample (16/40) suffered at least one serious head injury. Sixty-five percent (65%) of head injuries were to the brain and only 32.0% to the skull.
- In urban motorcycle accidents, brain is most subject to contusions, haemorrhages and hematomas.
- The most frequent causes of head injuries were the impacts with the windscreen, pillars and doors, but also the head-to-ground impacts must not be neglected. The high sample weight was mainly due to a frequent loss of the helmet after the primary impact with the OV. Losses were mainly due to helmets not properly fastened, helmet wear and to an unfit helmet size.
- In spite of a small dimension of the sample, a value of 30 km/h could be taken as a threshold speed beyond which the number of injuries sharply increases
- Thorax is the body region mostly in need of protection: 36 out of 40 motorcyclists had at least one thoracic injury and 28 people had at least one serious injury (AIS3+). Lungs were the organ most injured. Pneumothorax and hemopneumothorax were important injuries although their low frequency.
- The percentage of thoracic injuries increase with the OV size: small, compact, large. The principal causes of thoracic injuries were impacts with door, A-pillar and bumper.
- Despite having suffered a lower percentage of serious injuries (44.1%) in comparison to other body-

regions, the abdomen have a higher percentage of severe (AIS4) and critical (AIS5) injuries suggests needs to be more protected too. The main causes for the abdominal injuries were the impacts with bumper, sill and ground.

- Femur (33.0%), pelvis (30.0%) and tibia (21.0%) were the lower extremities most subjected to injuries. Even if their severity never exceeded AIS3, the disabilities following from these injuries are not negligible. The literature shows as 80% of the lower limbs have experienced some functional limitation one year post discharge, despite lower limbs injuries accounted only 26% of the totality.
- The main causes of lower limbs injuries were the impacts with the fender, the door and the PTWs front glove compartment (for scooter).

Regarding the accident involving cyclists and pedestrians we have:

- Urban accidents with pedestrians seriously injured mostly occurred far from intersections (85.2%, 23/27). In this subset, 56.5% (13/23) of accidents occurred far from a crosswalk. And this leads to unexpected situation for driver-pedestrian interaction.
- The OV most frequently involved in pedestrian urban crashes were small and compact cars as well as vans. These categories effectively correspond to the most typical vehicles on Italian urban roads, so there is no deviation from the average circulating car sample.
- In a right-hand drive environment, most pedestrians were stuck on their left side by the right front corner of the vehicle. This could be due to the limited and short time since perception of the pedestrian by the car driver, to perform the avoidance manoeuvre when the pedestrian crossed from the right-hand side.
- From the pedestrian point of view, there were also oversight errors that brought him/her to cross the road without the necessary attention to the surrounding vehicles.
- Impact speeds in right and left-hand side accidents are statistically equivalent, and close to the maximum legal speed on urban roads. This suggests that: 1) the vehicle's speed in urban environment is too high; 2) in both configurations the driver reacts too late to implement an effective braking action; 3) there is primarily a perception failure of people involved in the accidents.
- In vehicle-cyclist accidents, the cyclists were more frequently hit sideways.
- Despite the fact that the average impact-speed was slightly lower than the impact-speed of the pedestrian subset, the mean outcome score was more severe. Cyclists generally hit the vehicle in an upper and stiffer point (commonly at the upper frame or at the windscreen area close to the frame).
- Pedestrians have the head-neck-face region and the lower limbs most exposed to injuries.
- In terms of severity, head and thorax were the pedestrian body segments most seriously injured (AIS3+). The most common head injuries were epidural and extradural hematoma (moderate and severe), brain swelling and lacerations, while the vault fractures represented the most serious skull fractures (from AIS2 to AIS4).
- Pedestrian's head injuries were mainly correlated with head/A-pillar impacts, head/upper frame and head/windscreen impacts. The A-pillar was the car part most responsible both for the numerosity and for the severity of the injuries (AIS2+).

- The windscreen area closest to its frame, due to the higher stiffness, it was more dangerous (both in term of injuries and severity), while the central part of the windscreen causes less severe injuries (AIS<2).
- Nonetheless, there were some head/upper frame impacts that had produced minor injuries (AIS<2). The lower severity was attributed primarily to the reduction of the head impact speed in the contact with the upper frame thanks to a preliminary contact of the shoulder and/or arm (shielding effect).
- Despite the bonnet was less responsible of head injuries, all the impacts were associated to serious injuries (AIS3+).
- The most serious thoracic injuries were pneumothoraxes, while the most frequent spinal injuries were spinous and transverse process and fractures to the vertebral body.
- Injuries at lower limbs accounted for 18% of the total pedestrian injuries, while the most frequent and severe ones were localised in the pelvis (from AIS2 to AIS4).
- The latter injuries were related to the primary contact with bumper and BLE. The most severe ones were also associated with a higher level of car frontal damage (in the area of BLE), suggesting a correlation with the vehicle speed.
- As a concluding remark, it is worth noting that impact with ground accounts for more than 25% of injuries reported by pedestrians and cyclists.