Deliverable 3

Infrastructure

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**Project Coordinator:** Aline Delhaye, Federation of European Motorcyclists’ Associations (FEMA), Rue des champs, n°62, 1040, Etterbeek (Brussels), Belgium

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**Organisation name of lead contractor for this deliverable:**  
Federation of European Motorcyclists’ Associations (FEMA), Belgium

**Report Authors:**  
Aline Delhaye, Federation of European Motorcyclists’ Associations (FEMA), Belgium  
Laura Marot, Federation of European Motorcyclists’ Associations (FEMA), Belgium

**Report Reviewers:**  
Peter Saleh, Federation of European Highway Research Laboratories (FEHRL), Austria  
Kris Redant, Federation of European Highway Research Laboratories (FEHRL), Belgium

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### Glossary

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>2BESAFE</td>
<td>2-Wheeler Behaviour and Safety (research project)</td>
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<tr>
<td>ACEM</td>
<td>The Motorcycle Industry in Europe</td>
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<tr>
<td>AIT</td>
<td>Austrian Institute of Technology (Austria)</td>
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<tr>
<td>AMVIR</td>
<td>Association of Motor Vehicles Importers Representatives (Greece) - Σώνος Εισαγωγής Αντίπροσώπων Αυτοκινήτων</td>
</tr>
<tr>
<td>ANCMA</td>
<td>Associazione Nazionale Ciclo Motociclo Accessori (Italy)</td>
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<tr>
<td>BASi</td>
<td>The Federal Highway Research Institute (Germany) - Bundesanstalt für Straßenwesen</td>
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<tr>
<td>BMF</td>
<td>British Motorcyclists Federation (United Kingdom)</td>
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<tr>
<td>BRRC</td>
<td>Belgian Road Research Centre (Belgium)</td>
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<tr>
<td>BU</td>
<td>Biker Union (Germany)</td>
</tr>
<tr>
<td>BVDM</td>
<td>Bundesverband der Motorradfahrer (Germany)</td>
</tr>
<tr>
<td>CEDR</td>
<td>Conference of European Directors of Roads</td>
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<tr>
<td>CEN</td>
<td>European Committee for Standardization</td>
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<tr>
<td>DACOTA</td>
<td>Data Collection Transfer &amp; Analysis (research project)</td>
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<tr>
<td>DG MOVE</td>
<td>Directorate-General for Mobility and Transport</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EN</td>
<td>European Standard</td>
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<td>ERF</td>
<td>European Road Federation</td>
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<td>ETSC</td>
<td>European Transport Safety Council</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>EuroRAP</td>
<td>European Road Assessment Programme</td>
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<tr>
<td>FEBIAC</td>
<td>Fédération Belge de l'Automobile &amp; du Cycle (Belgium)</td>
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<tr>
<td>FEHRL</td>
<td>Federation of European Highway Research Laboratories</td>
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<td>FEMA</td>
<td>Federation of European Motorcyclist's Associations</td>
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<tr>
<td>FFMC</td>
<td>Fédération Française des Motards en Colère (France)</td>
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<tr>
<td>FIM</td>
<td>International Motorcycling Federation - Fédération Internationale de Motocyclisme</td>
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<tr>
<td>FMI</td>
<td>Federazione Motocyclistica Italiana (Italy)</td>
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<tr>
<td>IFZ</td>
<td>Institut für Zweirad sicherheit (Germany)</td>
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<tr>
<td>iRAP</td>
<td>International Road Assessment Programme</td>
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<td>ITF</td>
<td>International Transport Forum</td>
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<tr>
<td>IVM</td>
<td>The German Motorcycle Industry Association (Germany) - Industrie-Verband Motorrad</td>
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<tr>
<td>KFV</td>
<td>Austrian Road Safety Board (Austria) - Kuratorium für Verkehrssicherheit</td>
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<tr>
<td>Lillehm.</td>
<td>Workshop on Motorcycling Safety, Lillehammer</td>
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<tr>
<td>LMI</td>
<td>Lëtzebuergier Moto-Initiativ (Luxembourg)</td>
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<tr>
<td>MAG Belgium</td>
<td>Motorcycle Action Group (Belgium)</td>
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<tr>
<td>MAG Ireland</td>
<td>Motorcyclists Action Group (Ireland)</td>
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<tr>
<td>MAG NL</td>
<td>Motorrijders Actie Groep (the Netherlands)</td>
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<tr>
<td>MAIDS</td>
<td>In-Depth investigation of motorcycle accidents (research project)</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>MCTC</td>
<td>MC Touring Club (Denmark)</td>
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<tr>
<td>MPS</td>
<td>Motorcycle protection systems</td>
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<tr>
<td>NMCU</td>
<td>The Norwegian Motorcycle Union (Norway) - Norsk Motorcykkel Union</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PILOT4SAFETY</td>
<td>Pilot project for common EU Curriculum for Road Safety experts: training and application on Secondary Roads (research project)</td>
</tr>
<tr>
<td>PROMISING</td>
<td>Promotion of mobility and safety of vulnerable road users (research project)</td>
</tr>
<tr>
<td>PTW</td>
<td>Powered two-wheelers</td>
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<tr>
<td>ROSA</td>
<td>Dissemination of European handbook on best-practice related to two-wheeled motor vehicles’ safety (research project)</td>
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<tr>
<td>SMART RRS</td>
<td>Smart Road Restraint Systems (research project)</td>
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<tr>
<td>SMC</td>
<td>Sveriges MotorCyklister (Sweden)</td>
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<tr>
<td>TC</td>
<td>Technical Committee</td>
</tr>
<tr>
<td>TEN-T</td>
<td>Trans-European Transport Networks</td>
</tr>
<tr>
<td>TRAFI</td>
<td>Finnish Transport Safety Agency (Finland) - Liikenteen turvallisuusvirasto</td>
</tr>
<tr>
<td>TS</td>
<td>Technical Specification</td>
</tr>
<tr>
<td>VRU</td>
<td>Vulnerable Road Users</td>
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Executive Summary

This deliverable reports on the work performed during the project and the main outcomes of the activities undertaken in relation to PTWs and Infrastructure. It focuses mainly on:

- Gaining a clearer picture of the common problems;
- Identifying priority areas for action through standardization and other targeted activities.

Riding defensively, scanning traffic precisely and anticipating risk situations are of vital importance for motorcyclists. Riders need to concentrate on the traffic rather than on road surface quality and properties. However, infrastructure deficits are often the primary or at least a contributing factor in motorcycle accidents. Road design, maintenance and construction are most often dictated by the needs of multi-track vehicles, with road standards and guidelines hardly taking the specific needs of PTWs into consideration.

Basic PTW design needs include:

- Consistent adhesion/grip/skid resistance in all weather conditions,
- Clear signs that riders can see and understand,
- Good mutual visibility,
- Minimum risk of colliding with obstacles.

Road maintenance requires the relevant authorities, road engineers and road safety experts to be properly trained or briefed in PTW-specific requirements. Road Safety Audit/Inspection Curricula and Road Assessment Programmes are key elements to be considered, while motorcyclist groups and ICT-based contributory processes (e.g. for identifying high-risk sites a.k.a. black spots) are coming up with interesting innovative solutions needing to be considered.

With the objective of gathering as much expertise as possible, the project collected feedback and information from different sources. Part of the work consisted of identifying and summarising the main outcomes of EU co-financed projects of relevance to accident reporting. These projects, available on the ERSO website, include 2-BE-SAFE, APROSYS, DaCoTA, EURORAP I and II, MAIDS, PILOT4SAFETY, PROMISING, RISER, ROSA, SAFETYNET, SMART RSS, SUNFLOWER+6, and WHITEROADs.

The project then worked at identifying priority areas for EU action according to the different stakeholders. This feedback collection took several forms:

- a literature review from the main related policy documents: Annex 14
- a questionnaire (Amplifying Questions) designed to survey the different categories of stakeholders directly involved into the policy making (Member States, the European
Union, the Motorcycling Community representatives, EU stakeholders). Answers to the questionnaire were collected via phone interviews, written answers or face-to-face meetings and are summarised in Annex 4/ annex 5/ annex 6/ annex 7;

input from project workshops: Annex 11 and annex 13

With the objective of gathering as much expertise as possible and including as much as possible stakeholders’ priorities, the project collected input from:

– **Member States’ Authorities**
  - Belgium: Department of Mobility
  - Bulgaria: Road Infrastructure Agency
  - Finland: Trafi
  - France: Conseil National de Sécurité Routière
  - Ireland: National Roads Authority
  - Latvia: Latvian State roads
  - Luxembourg: Ministère du Développement durable et des Infrastructures, administration des ponts et chaussées
  - Netherlands: Ministry of Infrastructure and Environment
  - Norway: Norwegian Public Roads Administration
  - Poland: General Directorate of National Roads and Motorways
  - Slovenia: Slovenian Traffic Safety Agence
  - Spain: Directorate General for Traffic (DGT), Ministry of Interior
  - Sweden: Swedish Transport Administration
  - UK: Road User Licensing, Insurance and Safety

– **Research community**
  - Austria: KFV (Austrian Road Safety Board); AIT (Austrian Institute of Technology)
  - Belgium: BRRC
  - Czech Republic: Transport Research Centre
  - Germany: BASt
  - Greece: National Technical University of Athens

– **EU stakeholders:** ERF, FEHRL, CEDR

– **Motorcycling Community (Industry/users)**

*Deliverable 3 - Infrastructure*
Belgium: FEBIAC; MAG Belgium
Denmark: MCTC
France: FFMC
Germany: BMW; IVM; IFZ; BU; BVDM
Greece: AMVIR
Ireland: MAG Ireland
Italy: ANCMA; Ducati; FMI
Luxembourg: LMI
Netherlands: Kawasaki; Yamaha; MAG NL
Norway: NMCU
Sweden: SMC
UK: BMF

Using the OECD/ITF classification, infrastructure issues can be classified in 8 technical categories

1. Road design, condition and maintenance
2. Junctions
3. Road surface quality
4. Debris, pollution and fallen loads/spillages on the road surface
5. Aquaplaning/hydroplaning
6. Roadside
7. Road restraint systems/barriers
8. Road maintenance works

FEMA, using an adapted version of the Haddon Matrix, has classified the PTW problems with infrastructure in 3 distinct working areas:

- road design and construction (including standardization),
- road maintenance and audits/inspections
- black spot management
Missing only input from the European Commission (no meeting with DG ENTR could be arranged in time despite several attempts), this data collection brought in many more outcomes than expected, enabling us to deliver the following:

- **A Picture of EU riders’ problems with infrastructure** and main geographical differences ([Annex 1](#))

- **A detailed Review of existing PTW/Infrastructure guidelines**, a list of common problems throughout Europe and EU standards to be reviewed to address priority issues. ([Annex 8](#))

- **A Summary of EU research work and main conclusions** for the past decade ([Annex 21](#))

- **Best Practices** among Member States (use of guidelines, PTW users as VRUs, black spot monitoring, “Vision Zero Roads” for PTWs)


- **A Pan-European Black/White Spot Report Form** for IT use and leveraging the knowledge of the motorcycling community ([Annex 16](#)).

- A **dedicated website** [http://www.mc-infrastructurer.eu/](http://www.mc-infrastructurer.eu/) aimed at providing information on safe motorcycling infrastructures for road authorities and stakeholders all over Europe and worldwide, identifying good practices and existing problems, with a view to improving safety for all road users.

- A **dedicated sub-website** specifically focusing on roadside barriers, also called “guardrails” or “crash barriers”, [http://www.mc-roadsidebarriers.eu/](http://www.mc-roadsidebarriers.eu/), which includes:
  - A **Motorcyclist Protection System Database**, a database targeting road authorities in Europe and providing them with an overview of available motorcycle protection systems (MPS);
  - **Guidelines for road restraint systems**, which aim to provide accurate and comprehensive information on the solutions available to road authorities and infrastructure operators wishing to upgrade road restraint systems. The guidelines present the current technical standards available, statistical data and in-depth research, accident profile configurations, as well as best practices and success stories. In addition, they feature a comprehensive list of road restraint products available on the market today, their characteristics, their use, the standards against which they are tested, and guidelines on where and how they should be installed to gain the best benefit.
Based on these inputs and a comprehensive review of needs, the project team identified a list of recommendations and priority action for European and national levels, summarized in the relevant *Reports for Action*.

Project Deliverable No 3 work was reviewed by RIDERSCAN Reference Experts from FEHRL: Peter Saleh (AIT) and Kris Redant (BRRC).
1. Introduction

Powered two-wheelers (PTWs) are a popular form of transport providing mobility to millions of people worldwide. However, unlike for other forms of motorized transport, PTW users, like cyclists, remain more vulnerable due to the intrinsic characteristics of the vehicle and the lack of a protective capsule.

Over the past decade, numbers highlighted a decrease in PTW casualties (mopeds and motorcycles). This decrease, albeit less pronounced than for other means of transport, is taking place against a substantial expansion of the number of PTWs on the roads.

In 2004, the MAIDS study\(^1\) highlighted the role of the road and its environment as being key PTW accident causation factors to be considered and addressed. According to this in-depth study based on over 900 accidents in 5 EU countries, infrastructure represented the primary cause of accidents in 7.7% of all cases studied, and was found to have contributed to the final outcome of the accident in 14.6% of them. All in all, the study found that:

- 30% of PTW accidents were due to road surface defects,
- 10% to inappropriate maintenance, design, road furniture or signs,
- 8% were primary contributing factor to the accident
- 6% represented hazardous traffic situations
- 6% design defects

\(^1\) [http://www.maids-study.eu/](http://www.maids-study.eu/)
With regard to infrastructure, the first international workshop on PTW safety\(^2\) in 2008 concluded that:

- **It was a fundamental safety requirement that motorcycles should have a place in overall transport policy and infrastructure policy/management.**

- **Each level of government should include measures in their infrastructure guidelines for accommodating motorcycles, developed with input from relevant stakeholders. The guidelines should be relevant to the needs of the jurisdiction concerned, and coordinated with other jurisdictions and levels of government. An international transfer of best practices was also recommended.**

- **The needs of motorcyclists should be included in the basic training for road designers as well as highway and traffic engineers.**

- **Identification and resolution of roadway design problems (e.g. accident black spots & “corridor” analysis) should include input from rider organizations & relevant experts.**

\(^2\) [http://www.internationaltransportforum.org/jtrc/safety/Lillehammer2008/lillehammer08.html](http://www.internationaltransportforum.org/jtrc/safety/Lillehammer2008/lillehammer08.html)
Since then, several EU research projects addressing the issue of PTWs and infrastructure (cf. Annex 21) have been conducted. The latest one, the DACOTA project\(^3\), concluded in its Road report\(^4\) (2012) that Road design should take into account the special needs of riders of PTWs in terms of both the design and maintenance of the road. These riders are much more vulnerable to imperfections of the road surface than car drivers, and special requirements have to be recognized for road markings, road surface repairs, longitudinal grooves, drainage etc.

**Where do we go from now?**

As the need to further improve infrastructure is now recognized among the road safety community, the RIDERSCAN project focused on

- Gaining a clearer picture of the common problems;
- Identifying priority areas for action through standardization and other targeted activities.

2. **Project activities and work overview**

2.1. **EU Research main conclusions** (Annex 21)

This section compiles a selection of relevant extracts from EU-financed research projects in relation with Infrastructure. These projects are available on the ERSO website (latest consulted on 15/03/2015).

The comprehensive list of selected extracts is available in Annex 21.

- **Contributing factors**

  Motorcycles have very different road performance characteristics than other types of vehicles. Certain manoeuvres and road conditions carry a higher risk to motorcyclists than to drivers. The road environment has a significant influence on the risk of crashes involving motorcyclists. Contributing factors include:

  - Interaction with larger vehicles (cars, trucks)
  - Road surface issues (such as roughness, potholes or debris on the road)
  - Water, oil or moisture on the road
  - Excessive line marking or use of raised pavement markers (a.k.a structured road markings assemblies or rumble strips in EN 1871)
  - Poor road alignment
  - Presence of roadside hazards and unprotected safety barriers

\(^3\) [http://www.dacota-project.eu/](http://www.dacota-project.eu/)

Since PTWs travel at higher speeds than other VRUs, they are often only regarded as vulnerable on second thought. On the one hand, PTWs are much faster than pedestrians or cyclists; on the other hand, such speed becomes a higher risk, e.g. in the presence of roadside obstacles. Another risk factor is the difference in mass between the colliding opponents. (PILOT4SAFETY)

Infrastructural measures to reduce speeds (such as humps or lane narrowing) have to be re-evaluated from the point of view of PTW rider safety. (PROMISING).

Identified problems related to infrastructure. (ROSA)

- Lack of consideration of motorcycles and motorcyclists during road design from a road safety point of view
- Lack of road design guidelines for roundabouts
- Lack of road design guidelines for intersections
- Lack of interaction with infrastructure in intersections
- Lack of guidelines for traffic calming systems
- Lack of anti-skid properties and lack of reflectivity
- Excessive line-marking
- Continuous change of the road surface state
- Lack of anti-skid properties
- Lack of knowledge about general recommendations related to road surfaces maintenance and skid resistance
- Lack of knowledge about interaction between potholes and road safety
- Lack of knowledge about interaction between dry goods, dusts and oil and road safety
- Harmful design of roadsides
- Poor maintenance of shoulders
- Lack of information about existing products and current standards
- Lack of recommendations about vertical signs and traffic lights
- Lack of definition of road safety audits from motorcyclist point of view
- Interaction among motorcyclists and the rest of road users
- The problem of blackspots and allocation of accidents
- The problem of road work: signaling
- Intelligent transport systems (infrastructure) and motorcycle safety
• Rural roads

- In the EU, around 32% of people killed on rural roads are VRU: 10% pedestrians, 5% cyclists and 17% riders of mopeds or motorcycles. (PILOT4SAFETY/ETSC)
- The analysis of the literature and the successive in-depth accident study show that there is a lack of data and there is a need for more in-depth PTWs accident studies. (SMART RRS)

• Understanding of vehicle-road interactions

- Making the road infrastructure “motorcycle friendly”, self-explaining and forgiving needs an in-depth understanding of the vehicle-road interaction and its dynamics. (2BESAFE)
- Research on accident scenarios and biomechanics is a prerequisite to work at improving infrastructure for PTWs. (ROSA)
- Detailed analysis with simulation tools (vehicle-infrastructure interaction simulation), as well as incorporation of data gathered in naturalistic riding studies, should take place in coming PTW related research projects. (2BESAFE)
- A strong need for further research regarding the interaction between motorcycle tyres and road surface condition. (2BESAFE)

• Loss of control

- Both mopeds and motorcycles have some special characteristics which directly or indirectly contribute to their relatively high number of accidents. They are single track vehicles, without a bodywork. The fact that they are single track vehicles means that the rider has some difficult handling tasks while controlling the vehicle, in particular during cornering or braking maneuvers and even more so in emergency situations to mitigate or avoid incidents. The single track character also implies that riders have more difficulty coping with imperfect road surfaces and obstacles on the road. This does not seem to be fully recognised by some road authorities. (PROMISING)
- Preventing loss of control of a PTW and mitigating the consequences of the possible accidents are two areas where infrastructure has a key role to play. (2BESAFE)
- The influence of skid resistance has to be discussed in future PTW safety research from another point of view, as it is expected that the macro texture of the road surface has an higher impact on PTW safety. (2BESAFE)

• Road surface

- Road design should take into account the special needs of riders of PTWs in terms of both the design and maintenance of the road. These riders are much more vulnerable
to imperfections of the road surface than car drivers, and special requirements have to be recognized for road markings, road surface repairs, longitudinal grooves, drainage etc. (DACOTA)

The environment for the PTW rider is quite different when compared to other forms of road transportation because PTWs and PTW riders are more sensitive to roadway conditions within the transportation environment. Surface deterioration or damaged bitumen (i.e., broken or separated asphalt, cracks, etc.) was found on 26% of all roadways; road surfaces had defects in 30% of cases. (MAIDS)

- **Roadside furniture**

  The available studies show that the impact of motorcyclists against a fixed object occurred in 4% of the cases in urban areas while it varies between 10% and 20% in rural areas which can seems a small figure. However, a fatal outcome is 2 to 5 times more likely for an impact with a crash barrier than for motorcycle accidents in general. (SMART RRS)

  Existing rails have not been designed for collisions by PTWs and may cause severe injuries to their riders. The costs of fitting these devices can be reduced by selecting road sections where collisions by motorcycles are more frequent, i.e. in tight curves in rural areas. (DACOTA)

  Wire Rope Safety Barriers are viewed by motorcyclists as the most aggressive form of RRS. This view is supported by computer simulations and tests, which indicate that injuries will be severe if a rider hits the cables or the support. (SMART RRS)

  Despite the fact that some countries have already established their own regulations for testing motorcyclist protection systems (France, Spain, Portugal), existing systems still have very different designs and effectiveness, and the development path needs to be increased. (SMART RRS)

  Most motorcycle collisions with crash barriers occurred at shallow angles (typically between 10° and 45°) with the rider typically sliding into the barrier at a bend. However, the in-depth study has demonstrated that larger impact angle are also possible and must be taken into account. (SMART RRS)

  Risk for motorized two wheelers is particularly high and solutions are needed to minimize the severity of injuries resulting from their impact with roadside furniture. (DACOTA)

  In the future, cars and roadside obstacles have to be designed to provide better protection for riders of mopeds/motorcycles who collide with them. (PROMISING)
- **High risk sites**
  - Characteristics of PTW accident spots are in some points comparable within the European context, but other black spots specifications are even in one country unique – statistically insignificant, but highly dangerous. (2BESAFE)
  - An added problem is that the black spots for motorcycle accidents are unclear, as they are wide spread through the road network. (SMARTRRS)

- **Safe system approach**
  - Road infrastructure should be designed taking account of the same injury tolerance criteria as those developed for vehicle occupant protection and pedestrian impacts, so that roads and vehicles together provide an effective safety system; The principles of self-explaining and forgiving road environments should be applied to all road users, with special care for PTW safety issues. (DACOTA)
  - Road authorities seem to have neglected the special needs of riders of PTWs in terms of the design and maintenance of the road surface and fixed roadside objects. These authorities have to be informed on these special needs and special requirements have to be developed based on these needs for road markings, road surface repairs, longitudinal grooves, drainage, timing of traffic lights (for longer braking distances on wet surface) etc. (PROMISING)

- **Road Safety Audits/ Road Safety Inspections**
  - It should become common practise within the holistic approach of road safety management to include VRU safety; or to use (separate) checklists for VRU e.g. in RSI or RSA, to guarantee the specific focus on that road user group. (PILOT4SAFETY)
  - Guardrails have been designed for car collisions, but have adverse consequences in case of motorcycle collisions. Special studies from the point of motorcycle safety have to be done to result in special requirements for the design and location of guardrails. (PROMISING)

- **Standards**
  - Current standards related to road marking cover some aspects (products, durability tests, performance parameters,…), and these standards must be applied by the road marking manufacturers; some of these standards should be improved from the motorcyclist’s safety point of view of view. (ROSA)
  - 50% of the PTW accidents against a road restraint system, the rider is still in an upright riding position when the impact occurs, with the associated risks of being thrown on or over the barrier. Currently, this scenario is not considered in existing standards and is not included in the CEN/TS 1317-8. Moreover, very few studies have
been performed to assess this scenario up to now. This configuration represents a scenario to be considered in future work. (SMARTRRS)

2.2. RIDERSCAN pan-European Motorcycling Survey (Annex 1)

A survey targeting European riders was designed to collect information on the motorcycling community around Europe and to gain a better overview of similarities and differences in terms of riding, attitudes and safety needs.

The survey was conducted as an open participation survey, open to the general public in each participating country for 6 months. It was available in the following languages: Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hungarian, Italian, Norwegian, Polish, Portuguese, Slovenian, Spanish and Swedish. The survey was advertised through rider clubs and the national press. The Pan-European survey was disseminated at national level via riders’ groups and the motorcycling press as well as via Internet. It collected over 17,000 usable answers from 18 European countries (more methodological details in Annex 1).

It consisted of 4 parts:

I. General information: this part of the survey aimed at segmenting motorcyclists per country according to basic socio-economic information.

II. Mobility habits: This part of the survey aimed at understanding what kind of journeys motorcyclists undertake in general and more specifically with their powered two-wheelers.

III. Riding habits: This part of the survey aimed at gaining more details on riding habits.

IV. Safety habits: This part of the survey aimed at gaining more details on safety habits.

The analysis of the answers included the creation of a normalised European dataset and national datasets.
Figure 1 Main infrastructure problems faced by motorcyclists (EU sample)

Figure 2 Main infrastructure problems faced by motorcyclists (Area of Europe)
<table>
<thead>
<tr>
<th></th>
<th>Road maintenance</th>
<th>Road surface</th>
<th>Road markings</th>
<th>Road signs, roadside equipment, urban furniture</th>
<th>Road structure and design</th>
<th>Hazard signaling</th>
<th>Road works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>85.0%</td>
<td>69.0%</td>
<td>22.1%</td>
<td>16.8%</td>
<td>16.8%</td>
<td>5.3%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Belgium</td>
<td>83.4%</td>
<td>83.4%</td>
<td>22.1%</td>
<td>28.5%</td>
<td>20.3%</td>
<td>14.2%</td>
<td>13.6%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>86.1%</td>
<td>82.7%</td>
<td>30.6%</td>
<td>11.5%</td>
<td>22.5%</td>
<td>10.3%</td>
<td>9.4%</td>
</tr>
<tr>
<td>Denmark</td>
<td>78.1%</td>
<td>53.8%</td>
<td>15.4%</td>
<td>3.4%</td>
<td>18.0%</td>
<td>2.8%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Finland</td>
<td>93.1%</td>
<td>54.2%</td>
<td>9.5%</td>
<td>6.1%</td>
<td>9.1%</td>
<td>1.6%</td>
<td>7.1%</td>
</tr>
<tr>
<td>France</td>
<td>82.6%</td>
<td>85.0%</td>
<td>59.2%</td>
<td>33.5%</td>
<td>23.1%</td>
<td>17.3%</td>
<td>12.9%</td>
</tr>
<tr>
<td>Germany</td>
<td>90.9%</td>
<td>73.5%</td>
<td>16.7%</td>
<td>17.6%</td>
<td>13.0%</td>
<td>8.7%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Greece</td>
<td>90.8%</td>
<td>76.8%</td>
<td>19.0%</td>
<td>33.7%</td>
<td>58.4%</td>
<td>39.2%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Italy</td>
<td>92.4%</td>
<td>86.0%</td>
<td>46.7%</td>
<td>39.4%</td>
<td>11.3%</td>
<td>21.5%</td>
<td>15.3%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>69.9%</td>
<td>67.6%</td>
<td>40.9%</td>
<td>23.2%</td>
<td>16.6%</td>
<td>5.4%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Norway</td>
<td>66.0%</td>
<td>71.7%</td>
<td>11.2%</td>
<td>6.1%</td>
<td>34.0%</td>
<td>16.3%</td>
<td>14.4%</td>
</tr>
<tr>
<td>Poland</td>
<td>88.5%</td>
<td>87.2%</td>
<td>49.3%</td>
<td>14.2%</td>
<td>31.1%</td>
<td>4.7%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Portugal</td>
<td>88.9%</td>
<td>77.6%</td>
<td>47.6%</td>
<td>21.9%</td>
<td>27.7%</td>
<td>29.2%</td>
<td>21.4%</td>
</tr>
<tr>
<td>Spain</td>
<td>92.2%</td>
<td>81.3%</td>
<td>56.7%</td>
<td>43.3%</td>
<td>26.8%</td>
<td>27.2%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Sweden</td>
<td>86.2%</td>
<td>46.1%</td>
<td>5.2%</td>
<td>34.9%</td>
<td>-13.0%</td>
<td>7.2%</td>
<td>6.8%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>76.4%</td>
<td>74.6%</td>
<td>30.4%</td>
<td>21.2%</td>
<td>14.0%</td>
<td>5.1%</td>
<td>4.8%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>89.6%</td>
<td>72.5%</td>
<td>20.7%</td>
<td>16.4%</td>
<td>11.0%</td>
<td>6.9%</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

Figure 3 Main infrastructure problems faced by motorcyclists (Answer per country n≥100)
With the exception of France and Norway, all countries’ infrastructure priority is road maintenance (i.e. potholes, asphalt seals, etc.) (Figure 3 and Figure 4).

Road surface (pavement, rutting, manholes, slab joints, tram tracks, skid resistance) was always the second most important issue for riders, except for France and Norway where this issue came in front of road maintenance.

A less problematic issue appears to be roadworks, especially for Austria (only 0.9% of the respondents selected roadworks as one of the main infrastructure problems), Denmark (2.5%), Netherlands (4.2%) and Switzerland (4.8%). By contrast, in Greece and Poland roadworks were selected by 30.2% and 23.0% respectively of riders as one of the main infrastructure problems for riders.

Some specific national features:
in Denmark, unlike the rest of Europe, 3 issues were chosen by less than 4% of the riders as main infrastructure problems for PTWs: *Road signs, roadside equipment, urban furniture* (3.4% in Denmark against the European average of 28.8%), *hazard signalling* (3.4% in Denmark against 17.3% in Europe) and *roadworks* (3.4% in Denmark against in Europe 13.5%);

- only 1.6% of Finnish riders choose *hazard signalling* as an important infrastructure issue for riders, while the average for Europe is 17.3%.

- the issue of *road markings* is a particular problem in France (59.2% of riders) and Spain (56.7%);

- *Road signs, roadside equipment, urban furniture* is a one of the main problems in Italy for 39.4% of riders and in Spain for 43.3% of them;

- 58.4% of Greek riders and 34.0% of Norwegian riders selected *road structure and design* as one of the main infrastructure problems faced by PTW users;

- *Hazard signalling* is a problem in Greece (39.2%) and Portugal (29.2%);

- Greece seems to have the greatest problems with infrastructure, with 6 out of 7 issues getting more than 30% of the riders’ votes. Only *road markings* scored less (19%), while these seem to be a problem for the rest of European riders (38.7% - EU sample).

Infrastructure and accidents

![Figure 5 Accident type (all accidents declared merged) (EU sample)](image)

*To be noted: respondents were allowed to tick more than one answer (for example “tilting standing still” is considered as a single accident; therefore, both cases could be ticked without being inconsistent).*

- The highest rate of collisions with road infrastructure can be found in Finland (19.3%), Spain (12.3%) and Belgium (11.8%). In Denmark, of the 36 accidents declared, none involved a collision with road infrastructure.
The issue of infrastructure is particularly striking in Greece, Spain, Belgium, Italy and France where infrastructure problems were the causation factor in more than 30% of the near-missed accident experienced by our respondents.

![Figure 6 What was the most frequent factor causing your near-miss accidents? (EU dataset)](image)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>40.9%</td>
</tr>
<tr>
<td>Spain</td>
<td>38.6%</td>
</tr>
<tr>
<td>Belgium</td>
<td>37.7%</td>
</tr>
<tr>
<td>Italy</td>
<td>36.9%</td>
</tr>
<tr>
<td>France</td>
<td>36.5%</td>
</tr>
<tr>
<td>Finland</td>
<td>28.4%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>21.5%</td>
</tr>
<tr>
<td>Sweden</td>
<td>18.3%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>17.6%</td>
</tr>
<tr>
<td>Portugal</td>
<td>15.7%</td>
</tr>
<tr>
<td>Germany</td>
<td>13.8%</td>
</tr>
<tr>
<td>Norway</td>
<td>12.9%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>11.7%</td>
</tr>
<tr>
<td>UK</td>
<td>8.9%</td>
</tr>
<tr>
<td>Denmark</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

![Figure 7 Rate of infrastructure problems in causing near-miss accidents (answer per country)](image)

### 2.3. Common infrastructure problems in Europe (Annex 8)

The RIDERSCAN project collected and reviewed 10 sets of PTW infrastructure guidelines, identifying common recurrent problems and criticalities, and the related standards that would require revision to include PTWs specific requirements.
For consistency with other work in this field, the OECD classification was chosen to report on the common problems:

- **Road design, condition and maintenance**
  - Manholes and metal surfaces: a manhole in the middle of road can represents a change or loss of grip for a PTW
- **Pedestrian crossing markings** (in curves) and direction arrows etc.) can be an additional hazard on the road, especially in wet conditions because of their potentially reduced skid resistance.

- **Road markings**: the larger the painted area is, the more dangerous it is for motorcyclists. When they cannot avoid riding over it, they can lose grip on both wheels at the same time.

- **Roundabouts**: a too high entry angle can lead to excessive speed on approach, while a too low entry angle and central objects can hide a PTW from the view of other drivers.

- **Variable radius curves**: because of the changing position of the PTW in the curve the navigation point changes constantly.

- **Traffic calming schemes and speed bumps**: the location of traffic calming measures and the height of the raised section can be a great problem for PTWs.

- **Road surface quality as a % of loss of grip accidents**

  Poor-quality road surfaces involve repeated changes of grip for motorcyclists and are difficult to avoid and to anticipate.
- **Slippery surfaces**: patched surfaces, unevenness, re-texturing

- **Potholes and fissures**

- **Debris, pollution and fallen loads/spillage on the road surface**
  - Gravel, dirt, sand, debris, oil spills: road surface contamination is an obstacle that a PTW will try to avoid. At the same time it increases the likelihood of skidding, especially in curves or in zones with frequent acceleration or braking.

- **Roadside**
  - **Crash barriers**: Unprotected posts and barriers without under-ride protection constitute dangers for PTWs. Road restraint systems installed too close to the side of the road are more likely to be hit by PTWs, possibly with severe consequences.

  - **Obstacles** alongside and on the road represent major hazards for motorcyclists
- **Road signs and posts**: they can cause injury if a motorcyclist hits them, and they can also reduce visibility

- **Hedges/vegetation**: in a curve or when not well maintained, they can obstruct visibility

Using this list, the RIDERSCAN experts for Deliverable No 3, Kris Redant (Belgian Road Research Center - BRRC) and Peter Saleh (Federation of European Highway Research Laboratories – FEHRL/AIT), identified the relevant CEN standards that need revision and/or amendments.

- **Road design, condition and maintenance**
  - Manholes: EN 124 (TC 165): very vague about skid resistance
    
    *Technical note: the revised version of EN 124 (different parts) was approved (registration to national standards still pending) very recently. The new version stipulates that concrete surfaces or surfaces with a certain pattern (described in prEN 124-1:2015) should have sufficient skid resistance. For other designs, a pendulum test (giving a Pendulum Test Value or PTV) is required*

  - Road markings: road painting and pavement marking
    - Road marking materials:
      - EN 1423 (Drop on materials)
      - EN 1871 (Physical properties): **would need harmonisation**
      - EN 1790 (Preformed road markings): **would need harmonisation**
    - Performance:
      - EN 1436 (Performance requirements) = road marking performance for road users: skid resistance (friction coefficient) and visual performance (daytime and night-time visibility and colour)
    - Test: **A single durability test method is needed**
- EN 13197 (Indoor Wear Simulator test)
- EN 1824 (Road test)

- **Road surface quality as a % of loss of grip accidents**
  - Surface treatment = a maintenance technique to improve road surface characteristics for a limited period of time
    - EN 12271 (Surface Dressings) → EN 12272-2: Visual assessment of defects
    - EN 12273 (Slurry Surfacing) → EN 12274-8: Visual assessment of defects
      
      *Technical note: EN 12271 and EN 12273 are relevant for two maintenance techniques. Supporting standards for these two product standards include characteristics that could be relevant for PTWs and for which a closer look on how PTW interests are integrated would be interesting.*

    - EN 13108-1 (Asphalt concrete)
      
      *Technical note: EN 13108 parts 1 - 8 (and in the near future also part 9) are product standards currently containing mainly empirical specifications (properties for the mix and constituents). Future versions should slowly move to a more fundamental (performance-based) approach and could include characteristics relevant to PTWs. More or less comparable to what applies for MPS, it will become important to convince RA to take these special characteristics into account (or better: make sure that the characteristics that are beneficial for PTW are relevant for all road users).*

    - EN 13036 series - Parts 1 - 8: Surface skid resistance, unevenness, measurement techniques
      
      *Technical note: EN 13036-x (and also CEN/TS 15901-x) concerns measuring methods. Simplification (avoiding one MM/country) and - again - requirements that are appropriate for PTWs are needed.*

*The pendulum test is the most common test method for determining local skid resistance, though more dynamic methods allowing larger scale assessments are slowly being introduced. It seems unclear however what the relationship is between the results of these test methods and the slipperiness of a surface as experienced by a PTW rider.*

- **Roadside**
  - Crash barriers posts
    - CEN/TS 1317-8: currently reviewed and harmonized standard is now being implemented
  - Crash barriers too close to the road
There are no standards on the installation of Road Restraint Systems. Each country or even road authority can individually decide whether and how to install RRS

- **Obstacle**
  - CEN/TC226 (road equipment): work on characteristics relevant for the safety of road users and evaluate 'performance under impact'
  - EN 12767 (safety under impact): passive safety of support structures for road equipment. The test assesses the impact of a small vehicle (900 kg) against certain road equipment. Possibility discussed to integrate PTWs in this assessment
  - There are no standards on the installation of obstacles or how to handle existing obstacles

- **Signposting**
  - EN 12899-1 (Vertical signs): this standard consists mainly of characteristics concerning visual performance and stability.
  - For 'safety under impact' it refers to EN 12767.
  - CEN/TC50: EN 40 (Lighting columns)
    - Technical note: the product standards EN 40, EN 12899 and certain others currently refer to EN 12767 when it comes to performance under impact. If PTWs are to be taken into account it will mainly be in EN 12767 where something needs to be done
  - EN 12966 (Variable message signs): this standard consists mainly of characteristics concerning visual performance and certain other characteristics of relevance to the electrical components.
  - EN 12368 (Traffic control equipment)

Overall, several standards already contain provisions relevant to PTWs. It is important that Road Assessment Audits (Inspections define threshold values that are appropriate and relevant for all road users (including PTWs)

### 2.4. Infrastructure/PTWs: best practices & priorities

Collecting the views and information from the various stakeholders involved in the areas covered by the project was part of the key activities to gain a better understanding of priority actions. This collection of feedback and information took several forms:

- A literature review from the main related policy documents: Annex 14
- A questionnaire (Amplifying Questions) designed to survey the different categories of stakeholders directly involved in policymaking (Member States, the European Union,
the Motorcycling Community representatives, EU stakeholders). Answers to the questionnaire were collected via phone interviews, written answers, or face-to-face meetings and are summarised in Annex 4/ annex 5/ annex 6/ annex 7

• Surveys targeting the riding population: Annex 1 and annex 3
• Input from project workshops: Annex 11 and annex 13

Based on this structured approach, the project team worked at identifying priority areas for EU action according to the different stakeholders, prior to summarizing convergences.

• Stakeholders’ Safety Priorities – Infrastructure

With the objective of gaining a preliminary overview of the key safety aspects to be considered in the PTW safety debate, and in the project safety areas in particular, the project team undertook a detailed comparison of the PTW safety policies of key PTW/road safety stakeholders.

The table below summarizes the identified key safety aspects for each key stakeholder.

It should be noted that the documents were not written at the same time, meaning that some of them are more up-to-date than others. For the complete overview of the PTW safety policies and reference details, please refer to Annex 14.

<table>
<thead>
<tr>
<th>D3 – Infrastructure</th>
<th>ETSC</th>
<th>Lillehm.</th>
<th>FEMA</th>
<th>EC</th>
<th>ACEM</th>
<th>ITP</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Road design optimization/curve and intersection/visibility and signage</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Inclusion of PTWs in the identification and resolution of roadway design problems (RSA, RSI, Black sport management)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Minimise roadside objects/PTW-friendly</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Improve road surface maintenance</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Improve road surface skid resistance</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Develop/apply construction/maintenance Guidelines including PTWs needs</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Training for engineers, road designers, and providers, local authorities, road safety auditors/inspectors</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Infrastructure standards to be reviewed to include PTW-specific needs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- A pan-EU Road Hazard Report Form</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- “Guiding” infrastructure / self-explaining roads</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Best practices (Annex 4)

**Mandatory use of PTW/infrastructure guidelines**

From the interviews held with Member State experts and the motorcycling community representatives, the project found out that several countries have infrastructure guidelines for PTWs, though most of them are not mandatory, with the exception of Norway and Ireland.

<table>
<thead>
<tr>
<th>No guidelines</th>
<th>PTW-specific guidelines</th>
<th>Infrastructure guidelines for all road users, including PTWs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>Austria</td>
<td>Ireland</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Czech Republic</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Greece</td>
<td>Finland</td>
<td>Sweden</td>
</tr>
<tr>
<td>Latvia</td>
<td>Germany</td>
<td>mandatory</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>Norwary</td>
<td>partly mandatory</td>
</tr>
<tr>
<td>Poland</td>
<td>Spain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Switzerland</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td></td>
</tr>
</tbody>
</table>

Austria and Germany have made the use of the guidelines on the TEN-T network mandatory and recommend their use on other roads.

Austria identified a lack of dissemination to local authorities, while the UK and France admit different levels of use throughout the country. The Netherlands is seen as the country with the lowest level of guideline adherence.

**Black Spot Monitoring**

Several countries have already introduced specific black-spot monitoring systems which include PTWs (Austria, France, Ireland, Luxemburg, the Netherlands, Poland, Spain, Sweden, and the UK), while others have but without specific consideration of PTWs (Belgium, Latvia). Several countries still have no specific black-spot monitoring programmes (Czech Republic, Finland, Germany, Greece).
Moreover, while roads are designed and regularly assessed, no specific assessment for PTWs is foreseen.

**PTW users as VRUs**

<table>
<thead>
<tr>
<th>Riders/passengers on PTWs are legally considered as VRU on all roads.</th>
<th>Riders/passengers on PTWs can be sometimes included as VRUs. But not from a legal perspective.</th>
<th>Riders/passengers on PTWs are NOT considered as VRU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Finland</td>
<td>Belgium</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>France (Judge decision)</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Germany</td>
<td>UK (for safety point of view only)</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luxembourg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only a few countries consider PTW users as Vulnerable Road Users (VRUs) in a legal sense, with a corresponding impact on transport policies (Austria, Czech Republic, Germany, Ireland, Luxemburg, Norway, and Sweden); conversely, the Netherlands and Belgium do not recognize them as VRUs at all. Finland, France and the UK have decided on an intermediate status, accepting their vulnerability from a safety perspective, but not a legal one.

**RV32 Vision Zero Road v2 - The perfect road with regard to PTW safety**

In May 2008 Norway opened what it described as the ‘Vision Zero Motorcycle Road’. On an approximately 15km-long stretch of road, measures were introduced to demonstrate the feasibility of producing a ‘motorcycle-friendly’ road, at reasonable cost. Measures included:

- Extensive modifications to crash barriers to include an under-run rail and ‘soft’ ends to protect motorcyclists.
• Lamp columns were moved away from the highway edge and placed behind the barrier wherever possible.
• Sign posts were replaced with ‘lattice’ type forgiving constructions.
• Large stones were moved away from the highway edge, run-off areas were created and un-surfaced side roads were asphalted at junctions to restrict gravel wash off, etc.

While some of the measures used (crash barrier under-run rails, surfacing of tracks joining the highway) are not applicable in an urban setting, the principle of reviewing road safety characteristics for PTW users is extremely relevant and cost-efficient.

EU Directive on Road Infrastructure and Safety Management

The EU directive of road safety management establishes procedures relating to road safety impact assessments, road safety audits and safety inspections for the TEN-T network. For the first time, PTWs were included in the audit requirements as VRUs. The project investigated whether this directive had improved motorcycle safety.

<table>
<thead>
<tr>
<th>The infrastructure directive brought improvement to motorcyclist safety</th>
<th>Not such improvement from the infrastructure directive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Finland (already high standards)</td>
</tr>
<tr>
<td>Germany</td>
<td>France (crash with barriers are too rare)</td>
</tr>
<tr>
<td>Ireland</td>
<td>Luxembourg (already safe roads)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>UK (already high standards)</td>
</tr>
</tbody>
</table>

• Member States (Annex 4, Annex 14):

In their interviews, Member State authorities and road safety experts were asked to identify EU standards to be reviewed and needs for EU harmonisation. This can be seen as a priority list of action though the list does not claim to be exhaustive.

EU standards to be reviewed

• EU standards on crash barriers (EN 1317) (Austria, Germany, Sweden)
• Crash barrier tests should include PTWs (Austria, Ireland)
• EU road surface standards (road quality (friction, evenness) for PTWs) (Austria)
• Clarification on merging EN 1317-5 with CEN/TS 1317-8 (Belgium)
• Adaptation of EN 1317-5 to the new continuing professional development (Belgium)
• Implementation of PTW-specific aspects in RSA and RSI procedures

5 European Directive 2008/96/EC
Need for harmonisation

- Harmonisation in road construction (Belgium, Bulgaria, Czech Republic)
- Harmonisation of road inspections for secondary roads (Austria, Greece)
- Formal exchange of knowledge between similar countries (Finland, Greece)
- Use of safety gear/clothing (Belgium)
- Authorization to filter (Belgium)
- A uniform policy towards the use of bus lanes, road verges; hard shoulders (Belgium)
- Integrate PTW demands in regular road maintenance requirements (Netherlands, Norway)

The EU should do nothing, the local level is better for infrastructure issues (UK)

- The Motorcycling Community (Annex 5, annex 14):
  The views of riders’ and industry representatives:
  - Improve the communication on the implementation of PTW-specific infrastructure guidelines through setting up a roundtable for PTW safety.
  - Need to find a way to motivate road engineers to use PTW infrastructure guidelines (e.g. arranging roundtables with engineers; making PTW guidelines mandatory).
  - The EU directive on infrastructure should include road inspections for secondary road.
  - The crash barrier test (EN1317) should include PTW specificities.
  - Improve the periodic maintenance of roads.
  - Improve traffic signalisation on roads dangerous for motorcyclists.

2.5. Other Stakeholders’ feedback (Annex 6, Annex 11, Annex 13, Annex 14):

As part of the data collection and validation processes, the project organized 3 forums, and discussed the deliverable outcomes with pan-EU stakeholders. The memorandums of the workshops can be read in Annexes 11 and 13.

Below is a compilation of interesting comments made by participants and/or speakers in relation to infrastructure topics discussed.
• Stakeholders workshops’ comments
  - In Norway we used to have **motorcycle guidelines** for highway engineers. Through the recently launched motorcycle strategy we decided to scrap these guidelines and include them in the normal manuals and handbooks because motorcycles are not exotic vehicles, they are part of the normal transport mix and should be treated as such. When the authorities sign a contract with the entrepreneurs for maintenance, the manuals form the basis for the contract, not the advisory guidelines.
  - **Barriers** are still a huge problem. In Sweden, in spite of the Infrastructure Directive, most fatalities involving motorcyclists and barriers are on the TEN-T network. Last year these accounted for 20% of all fatalities, and 5 out of 6 were on the TEN-T network. The Directive for Infrastructure and Safety Management has been implemented but there was no specific focus on vulnerable road users, which on motorways refers to motorcyclists. The Infrastructure Directive leaves a lot of margin for Member States to implement it. It is currently being revised, including how to cater for the needs of PTWs. A good step forward would be for any EU money awarded to motorways to include specific provisions for motorcycles. This would act as a good example for secondary roads.
  - New technologies to better **measure friction** are urgently needed to ensure that roads meeting friction standards. Loss of grip causes one-third or even more of accidents.
  - Even though there is goodwill and everyone understands the needs, it’s difficult to get things to change. We need to think about PTWs right from the beginning. Once something is implemented, it is too late and too complex to change.

• Pan-EU stakeholders’ feedback
The RIDERSCAN project also collected the views of pan-European stakeholders whose work relates to the safety area covered and discussed key project findings.

  • **ERF**
    - Though infrastructure is the responsibility of Member States, one could propose a minimum level of understanding among Member States to apply certain solutions. Possible actions for the European Union would be to promote the use of minimum safety requirements (barriers, markings, passive support structures EN 12767) but this could be made in cooperation with the CEDR.
- Standards: This is not a really popular issue because different solutions already exist. You don’t need a “harmonised standard” to have a solution deployed at national level; the same goes for other standards (e.g. manhole covers) for which solutions already exist;

- Skid resistance: different sorts of marking exist (e.g. painting, tape, etc). It would be interesting to have studies to understand what kind of marking constitutes a problem for motorcycles. One suggestion would be to update the standards to make sure that requirements take the specific features of motorcycling into account.

- Signposting: Forgiving posts exist. But once again, testing is done with cars. What needs to be done here is to adapt posts and tests to motorcycles. And this would be really interesting as, when you have forgiving obstacles, in most of the cases you no longer need roadside barriers.

- Tests simulating motorcycle accidents: it would be good to arrive at a consensus on testing basic road safety equipment for motorcycles as well, but also feasible from an industry point of view. At present, the testing methods for motorcycle equipment would require huge investment on the part of manufacturers, but the demand from Member States is not there to justify this investment. Solutions must be affordable and feasible in a practical way.

- Road assessment: the EuroRAP star rating methodology does not insist on performance.

• CEDR:

- CEDR members are responsible to their respective ministries for the standards and operation of roads within the member countries. Therefore, notwithstanding national subsidiarity issues, should the EU Transport Ministers consider there is a need for a pan-European agency to address road infrastructure standards, then CEDR and its members – the National Road Administrations – will adapt accordingly;

- As things stand, CEDR members are already cooperating on the development of asset management practices at a European level. The voluntary cooperation between the member countries demonstrates the value thereof. This work has already delivered a common core system for asset management to be deployed by national road administrations: recommendations and a guide for implementing the core system in each national road administration; as well as common items and remaining asset management disparities between national road administrations.

- CEDR cannot compel Member States to follow its guidelines, but the process of consensus building between the respective national road directors encourages
voluntary adoption while respecting specific national conditions.

- CEDR continues to strengthen cooperation between its member national road agencies as well as with other relevant bodies.

**EURORAP**

- EuroRAP and iRAP possess a shared methodology that already provides for a star rating for PTW safety. The methodology used by EuroRAP to rate roads is a drive-through methodology. For each 100-meter stretch of road, 52 elements possibly leading to an incident are recorded. One point that could be interesting for motorcyclist is to identify infrastructure elements related to PTW accidents. The Star Rating and Safer Roads Investment Plan components of the RAP protocols could be used to complement any Road Safety Audit/Inspection.

- The EuroRAP model basically targets cars and needs to be improved for other road users. This is basically because worldwide research is much stronger for cars than for other road users. Therefore, there are a number of gaps that we feel need to be filled. Where research results are thin in the motorcycle model, assumptions taken from the car studies are made. It would be great to test the model on a “vision zero” road because the number of stars achieved ought to be high. If the raw results have any low stars we can determine why this is the case and use this to advance the model and refine it for motorcyclists.

- For EuroRAP, it would be useful to have data on how a motorcycle reacts on the road, what infrastructure issues are really problematic for PTWs and which standards are involved. There are multiple references in the documents to standards being for roads that do not consider motorcyclists’ needs. It would be useful to evaluate these with regard to having motorcycle star ratings.

- Ideally the “vision zero” stretch of road in Norway would be star-rated for all road users to see if it scores a minimum of 3 stars (on a scale of 5) each time. The results could then shape further research and development into the PTW dimension of the iRAP model.

**FIM/FEMA**

- The road environment has a significant influence on the risk of crashes involving PTWs. Contributing factors include road surface defects (such as unevenness, potholes or debris on the road); the presence of slippery material (water, oil) on the road; road markings with insufficient skid resistance or the use of raised pavement markers; poor road alignment; the presence of obstacles, roadside hazards and safety barriers, and interaction with other road users (including heavy goods vehicles, cars, cyclists, pedestrians and other
PTWs).

- Consequently, the quality of the road layout and proper traffic management play an important role in helping riders to control their vehicles, preventing loss of control, and influencing interactions with other road users. Infrastructure determines the way road users interact. The road layout has an important impact on the harmony and efficiency of interactions between road users, specifically between cars and PTW riders. More particularly, it can condition the capacity of car drivers to detect a PTW, and favour a driving speed conducive to safety, both elements recognized as critical in crashes involving PTWs. It is sometimes more effective to act indirectly on the road infrastructure than directly on the road users. Human behaviour is partly the product of the environment in which humans operate. The road layout will thus have a decisive influence on their activity, whether behavioural or cognitive (psychological).

- PTW-friendly road design, maintenance and infrastructure generally benefit all road users. The aim is to ensure that the safety of PTW riders is considered in the design and maintenance of roads and the implementation of traffic management plans.

- A consistent road and road environment invite road users to adopt appropriate behaviour. A self-explaining road allows road users to anticipate changes in the local road context.

- When potentially aggressive obstacles in the safety zone cannot be avoided, the last option is to isolate road users from these obstacles by the installation of a vehicle restraint system. However, some of these installations can be extremely aggressive for PTW riders. Crash barriers with unprotected posts are a real danger for motorcyclists.

- Allowing PTWs to use bus lanes is not necessarily a measure to improve safety, but rather to improve traffic flow. It has safety implications, however. Traffic management measures can have a dual purpose: facilitating PTW traffic and increasing safety.

- Engineers, road designers and providers, local authorities, road safety auditors and inspectors should be trained to consider PTWs in the design, construction, maintenance and operation of roads, and be provided with the necessary risk assessment tools to make the right decisions.

2.6. **Improving infrastructure for PTWs: key challenges**
PTW riders are more sensitive to road design and maintenance than car drivers. The design of roadway elements influences how a road user interacts with the roadway. These elements include bends, junctions, the road surface and the roadside. The general influence of road environment factors on the driving speed, level of vigilance, attention paid, accident severity is a well-known fact. Where an environmental perturbation can be managed by a car driver, it can be a real challenge for a PTW rider.

Since the first pan-European in-depth study on PTW accidents (MAIDS, 2004), several important milestones have been reached as regards PTWs and infrastructure needs:

- A number of guidelines on how to design and maintain roads with PTWs in mind have been published.

However, most of them remain just good intentions and are hardly used by local authorities and road engineers

- The “Infrastructure Directive”\(^6\) has been adopted by Europe; However, the Directive has hardly been used by road authorities to improve PTW safety and does not apply to the road network responsible for the largest number of PTW accidents, namely secondary roads.

- EuroRAP has included some PTW features in its star-rating system. But not all EU countries use either the EURORAP star-rating system or other road assessment programmes

- The CEN/TC226 has adopted a technical specification for Motorcycle Protective Systems

However, the CEN/TS1317-8 is still only a non-binding technical specification, despite years of campaigning. TS1317-8 should fully integrate EN1317, the European standard applied by all Member States in their national standards, and be included in their national road design guidelines.

- The need for political commitment

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\(^6\) European Directive 2008/96/EC
Today, one can say that with regard to infrastructure and PTW safety, all necessary preliminary steps have been taken, and all relevant experts agree on the need to better integrate PTW needs into road design, maintenance, and auditing/inspection. The necessary information and expertise is available in Europe. It is now a question of putting it all together, starting with the information collected within the project.

Without a clear political commitment to tackle infrastructure issues, market competition will play a delaying role deterring improvements. The example of EN1317 on roadside barriers (guardrails) and protection for PTWs is illustrative of the necessary time it takes for a standard to evolve without the involvement of public authorities.

- **Disseminating the information**

Disseminating correct information, making road authorities, planners and engineers aware of the problems on the one hand and existing solutions on the other hand, is another challenge that Europe should consider tackling.

In an attempt to contribute to a solution, the RIDERSCAN project has delivered the following outcomes:

**A pan-European PTW/Infrastructure website**

http://www.mc-infrastructure.eu and the sub-website http://www.mc-roadsidebarriers.eu/ aims at providing information on safe motorcycling infrastructures to road authorities and stakeholders throughout Europe and worldwide, identifying good practices and existing problems, so that safety can be improved for all road users. The sub-website is one of the many which tackle infrastructure issues in a more detailed approach. Other sub-website sections would include such topics as manhole covers, vertical signs, painted road markings, etc., with all information kept as neutral and objective as possible.
Directly available from the website are:

A **Motorcyclist Protection System Database** provides an overview of available motorcycle protection systems (MPS). The database targets road authorities, explaining to them the status of existing motorcyclist protection systems. Manufacturers are called upon to enter their MPS, while road authorities can compare existing products available on the market and use sophisticated search functions.

**Guidelines for road restraint systems** – A handbook for road authorities and infrastructure operators to upgrade existing road restraint systems. The Guidelines present solutions available to road authorities and infrastructure operators wishing to upgrade road restraint systems, presenting the current technical standards available, statistical data and in-depth research, accident profile configurations, as well as best practices and success stories. In addition, it features a comprehensive list of road restraint products available on the market today, their characteristics, their use, the standards against which they have been tested, and guidelines on where and how they should be used to gain the best benefit.
• Using riders’ community to identify road hazards (black spots) (Annex 16)

Several initiatives, including the actual writing of PTW/Infrastructure guidelines in some cases, have directly leveraged rider community expertise. These initiatives have been praised on several occasions by road authorities as they enable them to increase the efficiency of their actions.

Examples of such initiatives can be found here:

- Cross Sectorial collaboration in Germany
- Taking into account powered two wheelers in road infrastructure design in France

New technologies and smart applications are providing new opportunities to involve the rider community in identifying black spots in support of local road authorities’ efforts to improve the road network.

To this end, the project worked at designing a pan-European road hazard report form, which could support local initiatives while at the same time contributing to a common understanding of road hazard problems. The questionnaire targets everyday riders.

• Research needs (Annex 6, Annex 14):

PTWs have certain special characteristics which, according to the research community, directly or indirectly impact road transport research outcomes, whether for the safety of PTW users or road safety in general.

Dedicated consideration is required to gain a better understanding of PTW dynamics and interaction with traffic, and of specific accident causation factors, enabling us to identify risk domains and risk-contributing factors.

With specific regard to the infrastructure, the fact that PTWs are single-track vehicles, without an encapsulating protective shell, means that a rider may have difficulty handling tasks while controlling the vehicle, in particular when cornering or braking and even more so in emergency situations to mitigate or avoid an accident. Even with excellent brakes and tyres, vehicle control in all kinds of situations requires special training and experience or specific riding assistance systems on board the PTW. The single-track character also implies that riders have more difficulty coping with imperfect road surfaces and obstacles on the road.

Among the identified research needs in the field of infrastructure, the research community lists the following:

- Better understanding of PTW - infrastructure interactions
  - Improved data collection
  - In-depth understanding of the vehicle-road interaction and its dynamics, including detailed analysis with simulation tools (vehicle-infrastructure interaction simulation)
– Research on accident scenarios and biomechanics
– Incorporation of data gathered in naturalistic riding studies
– Interaction between motorcycle tyres and road surface conditions

**Safer road design:**
– Understand the effects of the road environment on road users
– A more forgiving road environment
– Making roads self-explaining for PTWs
– Improve the environment to enhance reciprocal perception of riders and drivers
– “Friction measuring” research
– Infrastructural measures to reduce speeds (such as humps or lane narrowing) have to be re-evaluated from the point of view of PTW rider safety
– Roadside obstacles need to be designed to provide better protection for PTW riders who may collide with them

**Road maintenance:**
– Development of more durable roads that are easier to maintain in a good state
– Development of “holistic asset management solutions”; how to make work zones safe?

**Black spot management:**
– Research on local accidents and on suitable countermeasures.

For detailed research topics and recommendations, please refer to the report on Needs for Policy Actions.

### 3. Deliverable conclusions

The first international workshop on PTW safety, hosted by the Norwegian Ministry of Transport, took place in 2008. Following 2 days of discussions with one hundred safety and PTW experts, the workshop came up with a top-20 list of recommendations to improve PTW safety, among which the fact that:

– *It was a fundamental safety requirement that motorcycles should have a place in overall transport policy and infrastructure policy/management.*

– *Each level of government should include measures in their infrastructure guidelines for accommodating motorcycles, developed with input from relevant stakeholders. The guidelines should be relevant to the needs of the jurisdiction concerned,* and
coordinated with other jurisdictions and levels of government. An international transfer of best practices was also recommended.

- The needs of motorcyclists should be included in the basic training for road designers as well as highway and traffic engineers.
- Identification and resolution of roadway design problems (e.g. accident black spots & “corridor” analysis) should include input from rider organizations & relevant experts.

In 2015, the OECD/ITF Motorcycle safety report\textsuperscript{7} (to be published) further underlines that:

- Infrastructure is essentially thought for cars
- Infrastructure should be improved to better integrate PTWs, taking into consideration the wide variety of users and the large speed differential at intersections;
- There is a clear problem of infrastructure maintenance (potholes, debris ..), to which PTWs are very sensitive
- With the development of self-explaining roads and appropriate traffic calming measures and PTW friendly equipment (“forgiving” roads)
- In some case, the use of dedicated lanes should be considered

One of the main strategic objectives of the European Commission Road Safety plans is to better adapt road infrastructure to PTWs. The mid-term review of the EC Communication on Road Safety 2011-2020\textsuperscript{8} is thus an opportunity to address the challenge, making use of the recommendations drawn up by the various experts, including the need to review existing EN standards to better include PTW requirements.

\textsuperscript{7} IMPROVED SAFETY FOR MOTORCYCLES, SCOOTERS AND MOPEDS © OECD 2015 (to be published)
\textsuperscript{8} http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52010DC0389