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Powered Two Wheelers - Safety Measures

Guidelines, Recommendations and Research Priorities

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none

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Description
Special thanks to all partners in 2BESAFE, who established an important basis for this volume by sending the authors of Deliverable 22 motorcycle relevant road safety programs as well as national and international guidelines (developed, discussed or implemented) related to PTW road safety. Special thanks to all PTW experts who have taken the challenge of filling the PTW measures questionnaire!

Abstract

Powered Two Wheeler (PTW) riders face a higher average risk of fatal or serious injury than most other road users, compared by mileage or number of trips. Behavioural issues are major moderating factors to PTW crashes, and the lack of separation between the rider and the environment is the main factor for the high severity accident rates. In order to propose relevant countermeasures to mitigate PTW rider fatalities and injuries, a broad-ranging research program was designed and implemented in the course of 2BESAFE. Amongst others, this program includes the development of recommendations for practical countermeasures for enhancing PTW rider safety. Assisted by these recommendations, the best available answer should be found to the key question: *What works in terms of motorcycle safety?* In detail, the target of this work package is preparation of a comprehensive list of currently applied and potential PTW safety measures, also providing relevant information on each of the measures.

"Measure" was generously interpreted and some of the items go beyond what is normally considered a "measure". Technical standards and legal provisions, research activities and methods are included just as well as road safety programs, visions and real hands-on measures like campaigns.

The "list of measures" was collected by two sources. On the one hand, 2BESAFE partners were asked for input and have delivered a total of 130 answered questionnaires describing measures, standards, guidelines and programs. On the other, numerous road safety programs were analyzed and all measures proposed within these programs were added to the "List of Measures".

At a later stage, more detailed descriptions for all measures were collected and all measures were rated by expert judgment so that a type of evaluation of the measures was performed that could indicate each measure’s effectiveness taking into account several factors that contribute to a measure being successful.

This volume provides information on about three dozens of road safety programs, guidelines and standards and about 150 measures addressing the issue of PTW safety.

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0. Executive Summary

0.1. Introductory Remark

WP6, "Transversal analysis and guidelines", of 2BESAFE (Powered Two-Wheeler Behaviour and Safety), a research project co-funded by the European Commission within Framework Program 7 (FP7) was designed to transform 2-BE-SAFE results into two useful products: on the one hand, the broad approach of this project exploiting diverse methods of research on driver behaviour are the basis for the development of guidelines for the observation of PTW rider behaviour. On the other hand, theoretical findings from WP1 combined with practical research results from WPs 2, 3 and 5 shall feed into guidelines and policy recommendations for the improvement of PTW safety throughout Europe.

This volume deals with the analysis of existing guidelines and provides a list of measures to improve safety for PTW riders. Therefore, existing guidelines from all relevant fields (vehicle, environment, driver, enforcement, etc.) were collected and analyzed with respect to the issue of PTW safety. On this basis, guidelines and policy recommendations for measures towards the improvement of PTW safety were developed. These guidelines and measures presented in this report address all relevant stakeholders (authorities, road safety organizations, road designers, road operators, PTW manufacturers, etc.) and should be considered in order to influence safety of PTW use.

0.2. Motivation

PTW riders face a higher risk of fatal or serious injury than most other road users, as well as a higher accident risk. The fatality rate per million kilometres travelled is, on an average, 18 times greater than for passenger cars. In 2006, L-category vehicles accounted for 2% of the distance travelled but 16% of road deaths in the EU-25. While other vehicle types have seen significant decreases in fatalities and serious injuries over time, respective figures for L-category vehicles only slightly decreased (Yannis et al, 2011).

Besides, the recent MAIDS (Motorcycle Accident In-Depth Study) study of PTW crashes in Europe found that behavioural and ergonomic issues were major contributing factors to PTW crashes. The majority of PTW crashes involved a collision with a car. The primary accident cause for PTW crashes was the failure of car drivers to perceive two-wheelers. The behavioural and ergonomic factors contributing to accidents involving four wheeled vehicles have been studied for a long time through laboratory and simulator research, observational studies and more recently by naturalistic driving studies, leading to countermeasures to reduce fatalities. But there is no comparable research for powered two wheelers; and there is a lack of research tools to study motorcycle rider behaviour.

In order to propose relevant countermeasures to mitigate PTW rider fatalities and injuries, a broad-ranging research program was designed and implemented in the course of 2BESAFE. This innovative program of research targeting on the behavioural and ergonomic factors contributing to motorcycle crashes focuses on the various scientific issues including the development of recommendations for practical countermeasures for enhancing PTW rider safety. Thus, the initial idea behind a "List of Measures" was directing the research work of 2BESAFE in a way to get the best available answer to the key question:

What works in terms of motorcycle safety?

The researchers should keep this list in their minds during the whole project and – wherever suitable and feasible – adopt their work, include additional aspect or do whatever is necessary to contribute to answering this question. In detail, the aim of this work package is the preparation of a comprehensive list of currently applied and potential PTW safety measures including advantages, shortcomings, potential implementation barriers and key success factors of PTW safety measures.

0.3. Methodology

In Deliverable 22, “Power Two Wheelers Risk Factors and Countermeasure Guidelines”, it was planned to make a list of guidelines for motorcycle safety and put these guidelines into a system in order to allow a maximum of readability, when recommendations have to be made at the end of the project. In order to structure the various guidelines and provide the access for statistical analysis, a questionnaire has been worked out and all partners in 2-BE-SAFE have been asked to fill it for each guideline they knew about. Overall, more than 130 questionnaires were filled and 107 different guidelines for the list of guidelines were considered. Although a lot of PTW-related measures are not covered by any of the guidelines in Deliverable 22, it serves as a very comprehensive basis for this report.

Besides, several studies on accident causes and risks of PTW riders were considered: On the one hand, the main PTW crash causes were gathered and on the other hand, some potential countermeasures to tackle common PTW crashes were taken from these studies. Based on the results from these studies, further applicable measures to reduce the accident risk of PTW riders were deduced, too. As an additional source for this report, various international road safety programs were also used.

Thus, the whole report consists of an enormous amount of measures and is mainly based on:

- Guidelines listed in Deliverable 22
- Studies on accident causes and risks of PTW riders
- Road safety programs

The gathered PTW-related measures proposed in this volume were analyzed concerning their beneficiaries and examples corresponding to the proposed measures were searched.

The process of collecting measure was extended until the beginning of the remaining work within WP6 in order to come to an updated List of Measures and include new activities before the final analysis was initiated.

Within Activity 6.2 of 2BESAFE, additional information was collected for all of the measures collected before. Main input for this was derived from research carried out within 2BESAFE. However, 2BESAFE did not create (and, did not aim at creating) new research results on all of the topics included. Hence, this input also includes experience of the experts commenting on the measures and to a certain extent, also results from desk research carried out by these experts.

Finally, within Activity 6.4 a star rating was added to each measure. It comprises the condensed expert judgement of PTW safety experts, who were active within 2BESAFE. They were presented a short description of all measures collected before within a huge questionnaire, which was created using the "Lime Survey" web application.

Al measures were rated by

- Size of the problem
- Impact (safety, mobility, travel times, environment, to other road users, overall)
- Safety
- Efficiency of the measure, i.e. relation between costs and benefits
- Implementation (organisational, legal, technical and political barriers)
- Transferability
- Acceptance
- Sustainability
- Best Practice (a definition of Best Practice was not provided deliberately)
- Priority

Assessment by 40 experts was processed and transformed to a star rating in these issues.

0.4. Fields covered by the "List of Measures"

This report concerning the analysis of PTW guidelines covers a wide range of fields with respect to PTW safety (Table 1):

Table 1: Fields covered by the report

Chapter	Fields Covered
Institutional Organisation of Road Safety	Road Safety Visions
	Road Safety Programmes and Targets
	Road Safety Guides and Studies
Road Infrastructure	Self-Explaining/Forgiving Roads
	Measures for Urban Traffic
	Pavement
Vehicles and Safety Devices	Brakes
	Passive Safety Devices
	Advanced Rider Assistance Systems
Conspicuity & Lights	Improvement of Conspicuity
	Installation and Type Approval of Lights
Environmental Issues	Issues concerning Air Pollution
	Issues concerning Noise Pollution
Protective Equipment	Standards
	Various Components of Protective Equipment
Driver Education, Licensing and Testing	Licensing, Basic Training
	Post Licensing Training
	Behaviour
Traffic Law & Enforcement	Enforcement (Strategies)
	Regulations concerning Driving Manoeuvres
Road Safety Education and Campaigns	Ways to Promote Motorcycle Safety
	Improvement of Awareness
Rehabilitation and Diagnostics	Rehabilitation of Severe/Young Violators
	Traffic Psychological Assessment
Post Accident Care	Improvement of Emergency and Post-Injuries Services
	Motorcycle Issues in Emergency and First Aid Trainings
Road Safety Data and Data Collection	Improvement of Data Collection
	Ways to Collect Data
Measures involving other Vehicles	Other Road Users' Responsibilities to Riders
	Use of ITS
Other Measures	Responsible Advertising Policy
	Issues concerning Electric Vehicles

0.5. Quantitative Overview

The report on Powered Two Wheeler related guidelines contains an overall number of 144 measures. The largest number of measures was found within the category “Road Infrastructure” (35 measures), followed by “Vehicle and Safety Devices” (30 measures) and “Driver Education, Licensing and Testing” (20 measures). An overview is provided below in Figure 1.

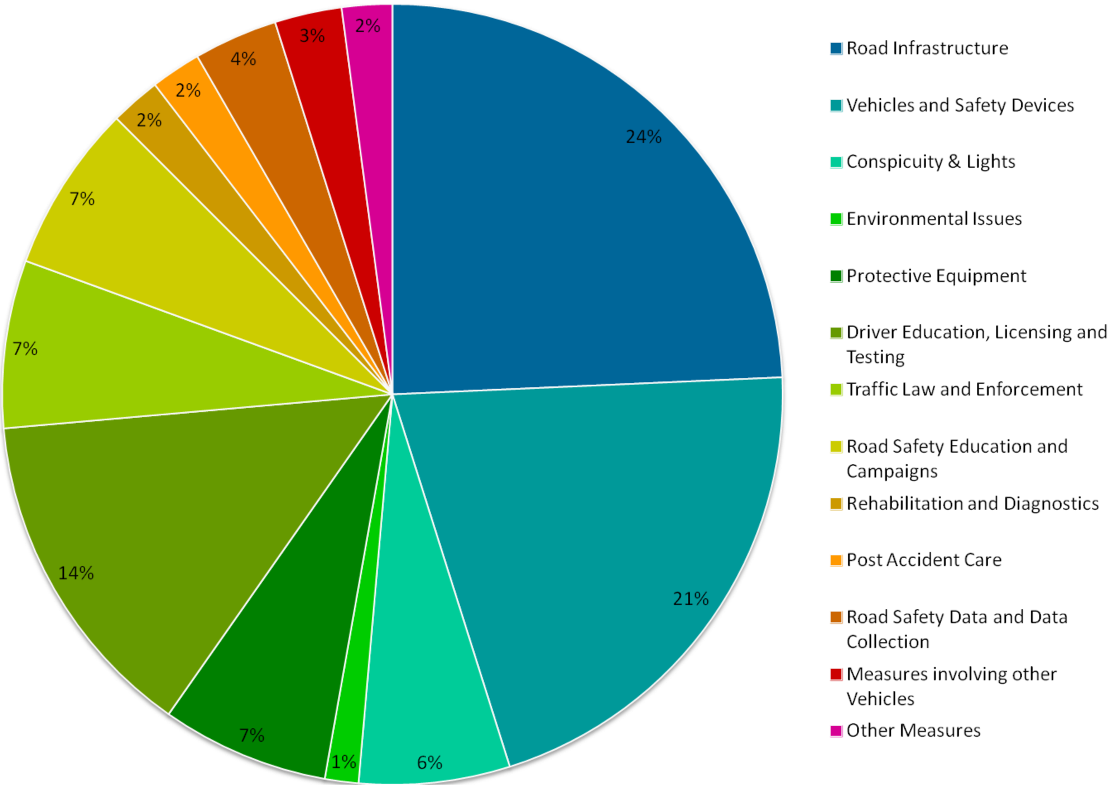

Figure 1: Quantitative distribution of measures by categories

0.6. Guidelines and Recommendations for Design of New PTW Safety Measures

To complete a comprehensive set of recommendations in terms of PTW measures, this volume also addresses issues to consider within design of (new) measures, which are not included in the "List of Measures". This part of the Deliverable shall provide assistance, where development and implementation of countermeasures is not sufficiently supported by experience from similar action taken before.

Part A - Methodology & General Recommendations

1. Introduction

1.1. Scientific Approach - Background

Work package 6 within 2BESAFE has the core purpose of transferring the results of the various studies carried out within the project into visible, understandable, practically applicable and easily accessible information. 2BESAFE has applied a wide variety of research methodologies, ranging from traditional analysis of macroscopic accident data through questionnaire studies, focus group interviews and conflict observation to naturalistic riding experiments. Some of these methods are well developed, some have a long tradition of application in other fields of road safety (i.e. mainly for car users) and some of the methods are rather new and have so far not been exploited to their full extent, at least not within the field of PTW riding behaviour and road safety.

The deliverables should address the typical user groups. There are two groups, which are of particular importance:

- Stakeholders involved in the application of PTW measures
- Stakeholders involved in the research on PTW safety

These might be overlapping somewhere. However, activity 6.3 of 2BESAFE will provide experiences and recommendations upon the application of research methodologies. Lessons learnt and conclusions for future application of these and of other related methodologies will be summarized within Deliverable 27. This product is mainly dedicated to researchers on the field.

The approach of the other activities within WP6 follows a continuous leitmotif. At the beginning of the project, the most important problems in terms of PTW safety were identified in order to give advice to the researchers, recommending which issues to specifically look at within the course of the different research studies in 2BESAFE. Hence, Deliverable 22 ("Power Two Wheelers Risk Factors and Countermeasure Guidelines") collected

- existing guidelines from all relevant fields (vehicle, environment, driver) with respect to motorcycle safety
- specific risk factors of PTW driving and interaction with other modes of transport and the road
- typical scenarios of PTW crashes and injury causation
- moderating variables with impact on PTW crash occurrence

Potential research questions addressing enhanced safety of PTW were derived from this information.

The collection of PTW measures was an essential part of Deliverable 22, and was - with respect to its extent - added as an annex. Assisted by all partners within 2BESAFE, road safety programs, visions and single measures were collected from all over the world. Not all of them were safety measures (e.g. access of PTW to bus lanes), however, such measures were also included, if they had relevance to safety. A number of road safety programs and visions do not directly address PTW, but include measures affecting PTW (safety). The researchers in 2BESAFE were asked to consider these measures within their research in whichever way possible.

The results of this procedure were summarized in two different ways. On the one hand, WP and Task leaders of the various research activities within 2BESAFE formulated "Dedicated Reports", which include results relevant for a synthesis of recommendations; and particular recommendations, which were derived from these results. Hence, these recommendations were a basis for synthesizing common recommendations. The Dedicated Reports, originally planned to be Deliverables D23 to D26, i.e. the dedicated reports of Work Packages 1, 2, 3 and 5, were put together into a single document.

The second part of dedicated reporting was to provide additional information to the various measures collected in Activity 6.1. Content, extent and format of this additional information was discussed in a workshop and approved during the consecutive consortium meeting at Florence at the beginning of the third (and final) project year of 2BESAFE.

This volume contains the condensed feedback from researchers in 2BESAFE. It mirrors both the results of the various studies as well as previous experience of these researchers. Hence, this volume comprises qualitative statements by a large group of particularly experienced researchers about a comprehensive collection of currently applied PTW measures.

Within Activity 6.1, a short description, at least one example of application and information on beneficiaries was collected. Within 6.2, it was decided to add information addressing the following issues:

- Clear definition of the problem
- Size of the problem
- Scientific Background
- Expected impact
- Implementation
- Acceptance
- Sustainability
- Transferability
- Costs and benefits
- Priorities

Activity 6.4 finally added "star ratings" to the measures in several important categories that would provide a complete image of measure implementation on PTW road safety. In addition, a “star rating” was provided by FEMA, representing the opinion of the rider population.

1.2. How to use this Document

This document aims to be understood as an invitation to all stakeholders working on development, design, implementation and practical application of activities on the field of PTW safety.

Part A presents methodology and general issues about PTW-related measures.

In **Chapter 2**, the methodology used to assess the investigated measures as well as sample characteristics are presented.

Chapter 3 presents guidelines towards the design of new measures which is based on the input provided through the previous chapters. A few examples are also provided. Chapter 3 may also be considered as a concluding section of the work in Activity 6.4.

Chapter 4 briefly summarises the main findings and recommendations and provides conclusions about design of PTW safety measures and considering all the work in WP6 and some thoughts for future directions.

In **Part B**, worldwide institutional organization related to road safety of PTWs is presented. This includes three main elements: road safety visions, road safety programs and road safety targets. Hence, several integrated strategic documents from several countries and organisations are presented.

In **Part C**, the list of measures as well as their analysis are presented. In particular, a comprehensive list of activities is provided addressing key information for each of the activities, such as a short description of the activity, goals, effects, transferability and sustainability as well as efficiency. As a supplement to this information, a star rating set up by expert judgment is provided, awarding a maximum of five stars in the categories size of the problem, transferability, total impact, difficulty of implementation, safety impact, acceptance, efficiency and sustainability completed by an overall rating.

1.1. 2BESAFE contribution to assessment

It is very important to notice the 2BESAFE project neither did nor does claim to having contributed to all the measures described in the following. The approach in WP6 in general was designed to contribute to as many as possible. In order to facilitate as many contributions as possible, the collection of measures was placed at the very beginning of the project and the first “list of measures” was internally published within Deliverable 22 “Power Two Wheelers Risk Factors and Countermeasure Guidelines” to be considered within the following research activities wherever possible. But however, 2BESAFE focused on behavioural research; many of the measures are not suitable to be targeted by this research; and for sure, many of them could not be targeted at all, since no research was foreseen within the work plan of the project, which would allow for such contributions.

Work package 6 of 2BESAFE, in particular Activity 6.4 and the respective results in this volume was inspired by previous activities of collecting assessing measures, e.g. within

- ROSEBUD (Road Safety and Environmental Benefit-Cost and Cost-Effectiveness Analysis for Use in Decision-Making), which focussed on cost-benefit-assessment of road safety measure
- SUPREME (SUmmary and Publication of Best Practices in Road Safety in the EU-MEmber States), which tried to cover all fields of road safety work
- ROSE25, which collected good practices in Road Safety Education in 25 EU-Member States.

Contributions of research results within 2BESAFE to assessment of measures may be separated into two different kinds:

- General contributions:
  Such general contributions do not particularly address single measures. These are research results, which enlarge the background of knowledge, i.e. which can be used to widen the view on PTW-related measures. Results in WP1 may be considered the most important example. The aim of Work Package 1 (among other goals) was is to identify the factors that contribute to PTW crashes across Europe, including rider / driver factors. The results can be used as a background for assessment of a wide variety of single measures. Activity 1.1 has identified 20 prevailing scenarios in 5 European countries that account for most fatal PTW accidents and of the causal factors contributing to accidents. A wide variety of measures can be assessed whether to have an impact within one or more of these scenarios or not.
- Specific contributions:
  A pilot naturalistic riding study was conducted within Work Package 2. The knowledge and experience generated can be used - and was used - to assess the measure “Naturalistic riding studies” (see chapter 16) and - to a certain extent – “Field operations tests”.
  Another example could be the findings in Work Package 3. Deliverable 8 “Risk perception: its contextual parameters” provides extensive background on specific practices like filtering, lane splitting, overtaking, speeding and use of hard shoulder. Nevertheless, this research also provides insight to more general issues of PTW safety, e.g. general risk taking behaviour and risk awareness.

As well as 2BESAFE contributions can be separated into groups, this may be done with the measures by similar criteria:

- General measures:
  These can be found mostly within chapter 16. Improvement of statistical information about riders, infrastructure and vehicles as well as on accidents may contribute to improvement of more or less all kinds of activities which target PTW safety. In addition, all kinds of road safety visions, programs, targets and funding schemes may be considered general measures.
  Another group of general measure can be found within chapter 11. Although various activities of traffic education and driver and rider training may be considered specific (e.g. with respect to the timing or target groups), they are general in terms of content. The same applies to the use of PTW simulators. Several activities within Work Package 4 have delivered improvements in terms of using both car and PTW simulators. Where these activities were mainly focussing on simulators for research purposes, the logical next step - after achieving a sufficient level of fidelity – is use for education and training as well as an extended use for research on various fields of PTW safety.
- Semi-general measures:
  “Guidelines on Road Design”, “Road Safety Audit”, “Road Safety Inspection”, “Black Spot Management” are such semi-general measures. They address several different issues and specific measures but all within one array of topics (in the cases mentioned: road infrastructure).
- Specific measures:
  Such measures (predominantly) address a particular road safety problem.

There are some results within 2BESAFE, which have a strong relation to practical application of PTW safety measures. Deliverable 2 (Interaction between Powered Two-Wheeler Accidents and Infrastructure) provides research results, which may be used to improve assessment on the following measures:

- Signposting of Speed Limits at Dangerous Spots in Curves
- Clarification / Highlighting of Longitudinal Roadway Arrangement
- Enhanced lane separation by floor markings
- Elimination of Sight Barriers in Curves and Improving Sight
- Predictable Curvature
- Transitional vs. circular bends
- Elimination of Dangerous Obstacles in Bends
- Provision of Full Paved Shoulders
- Technical Standards for Road Restraint Systems
- Under-ride Barriers for Guardrails
- Guide Posts Made of Flexible Material
- Reconstruction of Intersection Points
- Speed Limits for PTWs
- Speed Limits at Hazardous Sites
- Ban on Passing
- Use of Bus Lanes by PTWs
- Skid Resistance: Magnitude and Consistency
- Road Surface Testing
- Improvement of the Transversal Slope (Crossfall) in Curves
- Improvement of Pavement Friction on New Asphalt Surfaces
- Reduction of Roadway Debris from the Roadway and Roadside
- Further Issues concerning Friction

Deliverable 9 (Relationships between rider profiles and acceptance of Advanced Rider Assistance Systems) performed research on acceptance of Advanced Rider Assistance Systems, namely:

- Fully Autonomous Systems
  - Airbag
  - Vacuum servo
  - Slipper clutch/back torque limiter
  - Combined braking systems (CBS)
  - Traction control system (TCS)
  - Emergency brake assistance (EBA)
  - eCall
  - ABS
  - Advanced front lighting system
- Assistive Systems
  - Adaptive cruise control (ACC)
  - Lane keeping assistant
  - Intelligent speed adaptation
- Warning Systems
  - Curve speed warning system

  - Collision warning system
  - Blind spot monitor
  - Tyre pressure control system
- Informative Systems
  - GPS Navigation
  - Night vision

A particular case is conspicuity. For no other topic, research within 2BESAFE was as close to the measures listed by this Deliverable. The results of Activity 5.3 “Development and Evaluation of Recommendations and Improvements Of Conspicuity” directly feed to the assessment measure “Alternative Front Light Patterns”. Respective information is provided within Deliverable 19 – “Evaluation results for the improvement of PTW conspicuity”. Activity 5.2 “Experimental Studies in PTW Visual Conspicuity” provides more general information, which relates to a couple measures:

- Mandatory Use of Headlights
- Type Approval of Lighting and Light-Signalling Devices
- Automatic Headlamps On (AHO)
- Guidelines for Improvement of Rider Conspicuity during Daylight Riding
- Guidelines for Improvement of Rider Conspicuity during Night-time Riding
- Automatic Dipped Beam Inclination
- Adaptive Front Lighting

Wherever considered relevant, research results from 2BESAFE are mentioned within the description of measures (mostly with the section on *scientific background*) and referred to like all other references from literature.

2. Assessment of Measures

2.1. Internet Questionnaire – Quantitative Answers

2.1.1. Introduction

In the course of work package 6.4 of 2BESAFE "Guidelines, policy recommendations and further research priorities", an easily accessible, understandable and clear display of these issues was targeted. Therefore, an online survey was created and all experts involved in 2-BE-SAFE were invited to take part. As the final result of this survey, a star rating for each measure should be delivered, including all the measures which had been proposed for evaluation. This rating was to be based on well-founded expert judgment. That means that the particular experts in the field of PTW safety were asked to provide their opinion. It was not required to rate the measures based on scientific evidence; the experts were asked to answer the questions based on all their experience and expertise with particular consideration of research results produced within the course of 2BESAFE.

2.1.2. Preparation of the Survey and its Design

The survey was developed with the help of “LimeSurvey”, which is an open source online survey application. Designed to be user-friendly, it enables users to develop and publish surveys, and collect responses, without having to write any coding.

As the storage of the database was limited, the survey had to be split into six parts, which were activated from 27th September 2011 to 24th October 2011. In total, 49 participants were registered for at least one part of the survey, 40 finished one or more parts, and 27 participants completed the whole survey.

In the end, the survey contained answers on 151 measures. For each measure, these eleven questions were asked. Questions were designed as arrays, multiple choice or single choice questions, whatever suited best to the purpose. For each of the investigated measures, a short description was provided; more details were available in Deliverable D22 of 2BESAFE, which was provided to the interviewees. Besides, one opening question (Q0) had to be answered at the beginning of each part of the survey.

Q 0) Which groups of stakeholder do you belong to? *(Multiple Choice= MC)*

Q 1) To which extent do you consider yourself an expert for this measure? *(Single Choice= SC)*. If the interviewees considered themselves "No expert at all" on the measure, the survey continued but all questions related to the investigated measure were skipped, and continued with Q1 for the next measure.

Q 2) What is the size of the problem that is addressed by this measure? *(SC)*

Q 3) Please rate the following aspects of the measure: *(SC, from 5 – very positive to 0 – very negative)*

Q 4) Where do you think this measure can be implemented successfully? *(SC)*

Q 5) Please rate the following statements: *(SC, from 5 – strongly agree to 0 – strongly disagree)*

Q 6) What are the most critical issues with the implementation of this measure? (*MC)*

Q 7) With respect to this measure, to which extent will be the acceptance of... *(SC, from 5 – will fully accept it to 0 – not at all)*

Q 8) Which groups would you expect to oppose the implementation of this measure? (*MC)*

Q 9) Will effects of this measure fade (e.g. behavioural adaption, risk compensation, people forget about educational measures,…)? *(SC)*

Q 10) What safety impact do you expect? (*MC)*

Q 11) Please rate the following statements: *(SC, from 5 – strongly agree to 0 – strongly disagree)*

The full questionnaire is included in Annex 1.

2.1.3. Data processing and definition of the star rating

The survey was anonymous, thus the record kept of the survey responses did not contain any identifying information about the participants. The only "personal" information asked was the opening question ("Which groups of stakeholder do you belong to?"). Most participants belonged to science (80%), the other was consisted by road users (35%) and riders (25%). The minority stated that they represented industry (10%), legislative bodies (5%) or educational bodies (5%). Infrastructure providers (0%) were not represented in the survey at all.

It has to be noted that the first question involved the perceived expertise of the participant on the investigated measure. If the participant did not at all consider himself/herself as an expert this measure was not evaluated by the expert. This was decided in order to obtain answers that are as close to reality as possible. Hence, due to this constraint, not all measures were evaluated by all participants; some measures were evaluated by a higher number of participants and some by a lower one. The highest number of participants that evaluated a measure was 40, the lowest one was 30.

With respect to the data processing, the following procedure was conducted (see Figure 2):

- Interviewees' self-assessment: As the final outcome should make sure that the opinion of experts in a specific field weighs more than the one of less proficient ones, each numerical answer (from 0 to 5) was multiplied with the expert statement provided in question 1.
- Weighting of answers: In order to have an accurate final score for each of the measures weights should be applied for each investigated factor. However, these weights should not be chosen arbitrarily. One may somewhat easily differentiate between the different categories which matter more and which less, but deciding on a weight factor without any background on such scoring may result in a completely wrong conclusion. Hence, no weights were applied for the different categories. Still, one can consider that the measures that score well in all categories are the first that should be prioitised for implementation.
- Merging of questions: Questions and sub questions, which dealt with the same issue, were merged in order to get fewer variables. This way, the number of categories could be reduced to these ten:
  - Size
  - Total Impact
  - Safety Impact
  - Efficiency
  - Implementation
  - Transferability
  - Acceptance
  - Sustainability
  - Best Practice
  - Priority
- Besides, the average per category was calculated for each measure.
- Ranking of measures: The measures were ranked on the basis of the ten categories and of the average. In order to get a maximum of five stars per category, the ranking was carried out as follows:
  - Rank 1 to 26: 5 stars
  - Rank 27 to 51: 4 stars
  - Rank 52 to 76: 3 stars
  - Rank 77 to 101: 2 stars
  - Rank 101 to 126: 1 star
  - Rank 127 to 151: no stars

- This means that a measure, which was ranked first in a category, was averagely assessed best in this specific category and received five stars, while a measure ranked last in a category was given no points.
- Calculation of the overall rating: As described above, points were awarded in ten categories, each of them having received up to five points. Hence, the maximum number of points a measure could reach was 50. To get the overall rating, the range from 0 to 50 was divided in six parts, and for each part, stars were assigned (from 0 to 5). Figure 3 shows the quantitative overview of the amount of measures per number of stars.

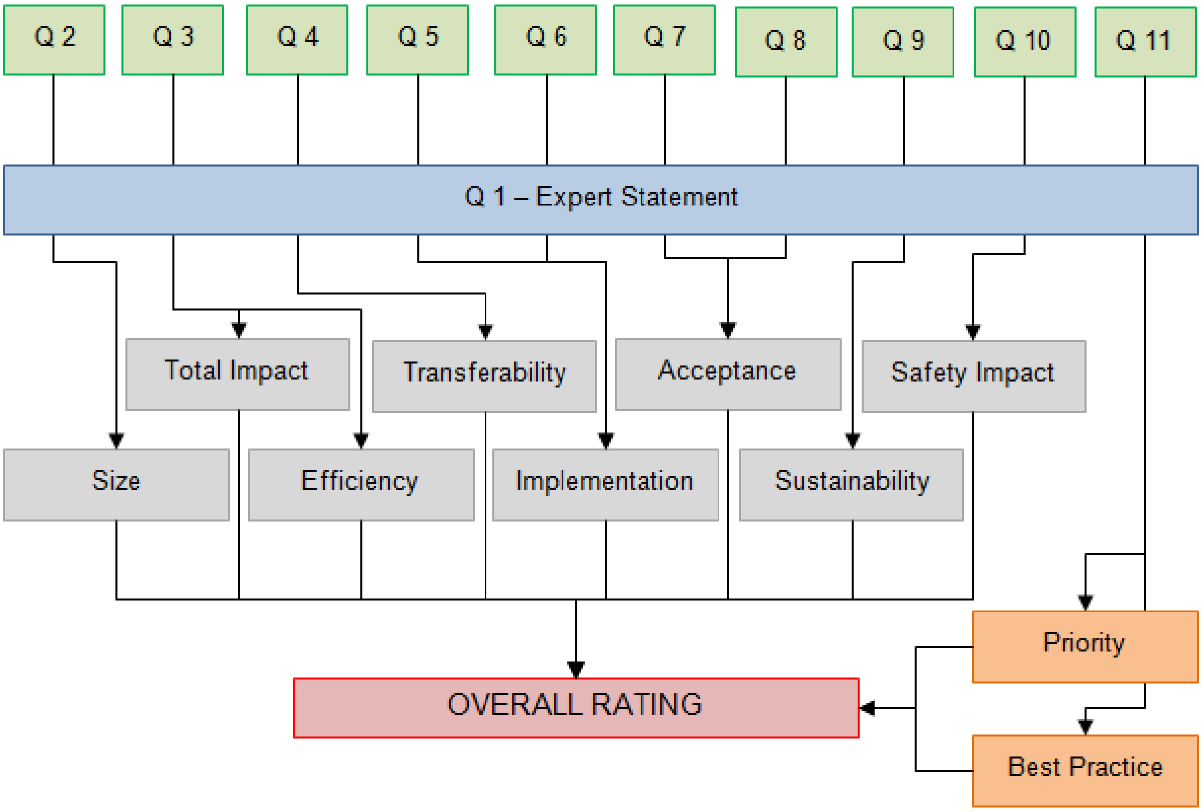

Figure 2: Data processing with respect to the star rating

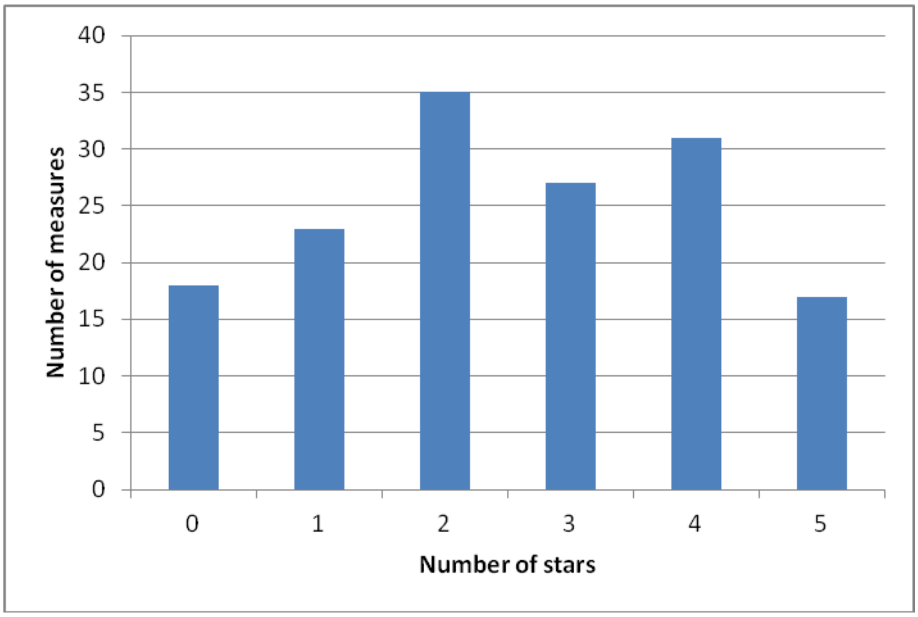

Figure 3: Quantitative overview of the amount of measures per number of stars

2.2. Description of measures

The second type of analysis is a simple desk-research activity. Each measure was described using a template covering the information the working group considered most important. The initial information collected within Activity 6.2 of the project (short description of the measure, examples, beneficiaries) was supplemented by more detailed scientific background, issues involving implementation, expected impacts, acceptance, sustainability and transferability issues. Cost-benefit figures were provided where available. The "Priority" section was used as a kind of summary integrating the expert rating and the qualitative description, look for discrepancies and find explanations where appropriate.

No additional research was executed to put together this information. In order to create a consistent document, the template was supported by a couple of questions to each of the headlines. The full template is included in Annex 2.

The work was distributed among the partners of Activity 6.2 by voluntary nomination. Each measure was described by a single person; the texts have undergone the usual redrafting procedures.

2.3. Riders' perspective

PTW riders are a particular group. For decision makers it may be an important issue knowing about what they have to expect in terms of riders' opinions towards measures. Such information is provided within the following descriptions. A statement and a separate star rating was provided by the Federation of European Motorcyclists' Associations (FEMA).

2.4. Limitations

It is obvious that a different sample of interviewees might have created a different result. However, the interviewees self-assessed themselves very high in expertise for all questions. The results may be biased by the self-selection - all experts participated in the same research initiative, hence they are mostly researchers, but not all of them in the field of PTW safety, but all of them having several years of experience within the field of road safety.

3. Guidelines and Recommendations for the Design of "New" PTW Safety Measures

3.1. Introduction

Assuming a limited availability of resources, road safety measures should be efficient. In 2004, Elvik (2004) found that effective countermeasures to accidents in macroeconomic terms are widely not applied due to political constraints. Elvik concluded that decision-making should more focus on sound and measureable approaches proposing cost-efficiency as the most appropriate one.

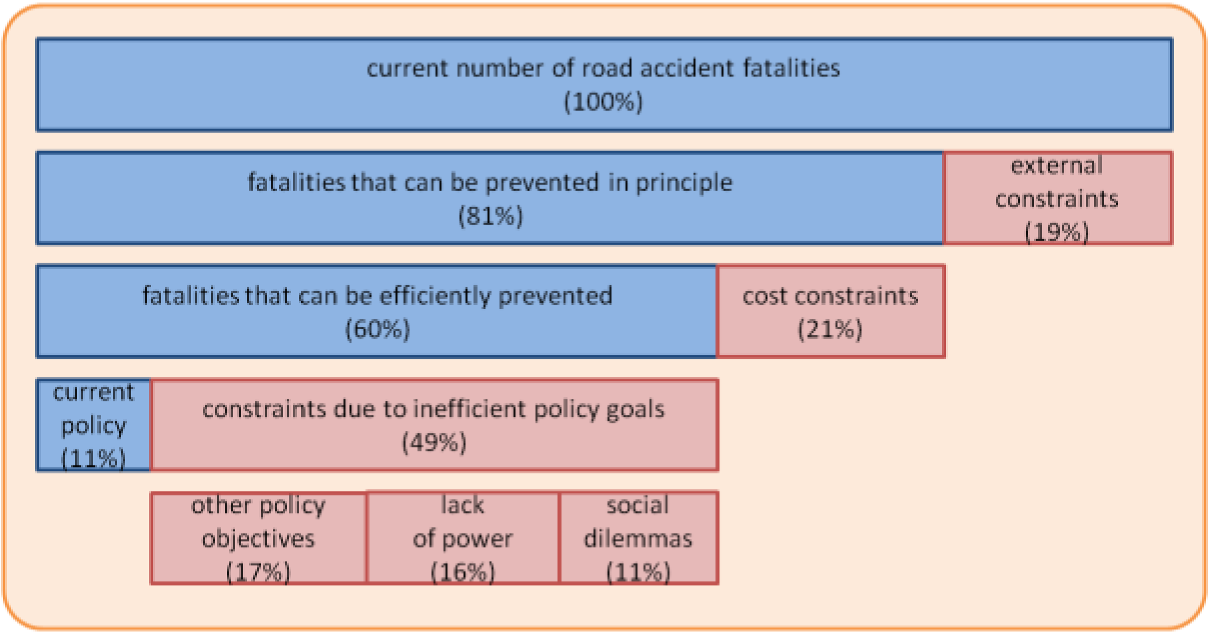

Figure 4: Preventable road safety fatalities

Efficiency assessment as a methodology of prioritising road safety activities was advertised by the ROSEBUD[1] and a couple of other European-Commission-funded projects. The approach was adopted by the SUPREME[2] project, which aimed at collection and assessment of road safety measures and identification of best practices.

SUPREME has set up criteria for measures to receive "best practice" status. The SUPREME definition of "Best Practice" can be helpful, when measures, which have not been applied before, have to be selected. In the following, these principles will be adopted in order to support decision making on PTW safety measure, where decisions have not received support from previous experiences. In addition, a comprehensive checklist is provided, which should be consulted before implementation.

3.2. Design guideline elements

3.2.1. Focus of a measure

The focus of a safety measure is the exact road safety problem the measure is intended to solve. The focus can be described using as one single element consisting of a combination of factors, which describe the preventive impact of the assessed measure:

[1] Road Safety and Environmental Benefit-Cost and Cost-Effectiveness Analysis for Use in Decision-Making, see *http://partnet.vtt.fi/rosebud/*

[2] SUmmary and publication of best Practices in Road safety in the Eu MEmber States, see *http://ec.europa.eu/transport/road_safety/projects/doc/supreme.pdf*

Accident type

- type of collision
- condition under which the accident occurs
- type of vehicle(s) involved in the accident

Road user

- personal or demographic characteristics (e.g. age, sex, length of licence ownership, car- or truck driver, aim of trip – commuting vs. pleasure)
- certain types of illegal behaviour (e.g. speeding, driving under influence, traffic violations)
- certain types of errors (e.g. lack of conspicuity, wrong perceived capabilities of PTW rider either from the rider or from another road user)

It should be noted that PTW safety measures do not necessarily address PTW riders. In particular in terms of conspicuity other road users have to be made aware of the problem. In addition, there are several countermeasures that do not involve road users at all, they are however relevant to other types of “groups”. For example, in terms of road safety audits or road safety inspections, road authorities, experts or other groups concerned should be targeted in order to include issues of PTW safety within these procedures. The same involves the design of road geometry/environment guidelines that also take into account PTW rider needs.

Road environment

- road environment (urban, rural etc)/road category/ type of intersection
- road geometry
- driving, pavement and weather conditions
- other characteristics of accident locations

Vehicle

- adaptations to vehicles
- prevention of unsafe participation in traffic
- other modes/vehicle category

Preventive impact

In addition, the first stage of assessment should provide a precise description about the **mechanism** by which the measure has an impact on the specified focus. If available, references should be provided to relevant **theoretical background** or empirical **studies**.

Passive impact

However, as already noted the high number of fatalities or serious injuries in PTW accidents is also the lack of separation of the rider and the road environment (together with the stability of the PTW etc). Hence, in addition to preventive impact that focuses on the aforementioned factors, passive safety measures that aim in mitigating the impact of an accident on PTW riders are also considered. Obviously, such measures are not based on the aforementioned factors.

3.2.2. Size of the road safety problem

Following the categorisation of the measure within the chapter on "focus", respective information should be provided addressing the size of the problem. This activity should start by providing a qualitative statement on each of the applicable categories and should be supplemented by quantitative information.

- What kind of impact is expected after implementation of the measure?
- What is the extent of the expected impact, e.g.
  - What is the share of accidents being affected by the measure?
  - To which extent are different levels of crash severity affected?
  - What is the share of road users being affected?

- What is the share of accident locations being affected?
- What is the share of vehicles being affected?
- Provide evidence for each of these questions, e.g. accident statistics, empirical evidence from experimental studies, theoretical background and expert opinions.

3.2.3. Expected impacts

Estimating the impact of a certain measure might on the one hand be the most difficult activity within evaluation and hence preparation of a road safety measure, but is on the other hand, the most important one. It may be considered that road safety might not be the only goal of a measure. Environmental impact and/or impact on mobility might also be an issue and should be described at this stage of assessment - at least qualitatively. For efficiency assessment, quantitative information will be required at a later stage. For the expected impact the effect on several related areas has to be investigated such as direct impact, side-effects, acceptance etc.

Based on the statements about size of the problem, qualitative information on the share of accidents, injuries and/or fatalities to be prevented by the measure should be provided. Relevant sources shall be provided.

3.2.4. Costs and benefits

In order to determine costs and benefits of a planned measure, quantitative information is needed at least for the safety impact. However, efficiency assessment in macroeconomic terms requires quantification of all expected impacts as well as respective monetary values.

Where there is no empirical evidence on size of impact, estimates should be provided. All considerations leading to the respective estimates should be provided in order to make this process as transparent as possible.

Type and amount of financial impact associated with the measure should be specified:

- investments
- maintenance costs
- enforcement costs
- reward systems
- administration costs
- long-term costs (ecological or social costs)

All cost categories should be considered, including the intended effects as well as all other impacts that have been identified.

- Safety
- Environment (exhausts, noise)
- Mobility
- Vehicle operation
- other

All these financial impacts have to be qualified either to be cost or benefit. In cases where negative benefits are likely to occur (i.e. side-effects), they should also be estimated. The distinction between what is "cost" and what is "benefit" is rather difficult and has to done using a "source and impact" approach. "Costs" are usually linked to the activity of setting up a measure; "benefits" are the resulting effects and can be either positive or negative, which will occur after the date of implementation. The ROSEBUD project produced the "Framework for the assessment of road safety measures", which provides assistance for the whole process of efficiency assessment (Höhnscheid, 2006).

Once this data has been collected, a benefit-cost-ration should be calculated and compared to other pending measures addressing other problems (budget-oriented approach) or other measures addressing the same problem (impact-oriented approach). In any case, the most efficient measure(s) should be selected for implementation.

3.2.5. Acceptance

Acceptance of the measure includes public acceptance, acceptance by road users, policy makers, and other stakeholders (e.g. automotive industry). It is related to attitudes and behavioural consequences of the measure, especially to willingness to apply the measure, or to comply to it. Other relevant issues can be political, legal, financial, technical and administrative aspects.

Acceptance is a particular issue in terms of PTW safety measures. Riders are a rather inhomogeneous group of road users. Experience valid for passenger car drivers might not be relevant to PTW riders. Hence, specific attention should be given to an objective assessment of acceptance.

PTW riders are a group of road users particularly keen on having their needs and wishes considered. In most of the cases it may be useful to consult rider organisations and implement a constructive process of consulting and discussion.

Distributional effects might be the most critical ones. If measures have a highly positive impact to one group of road users, but bring about negative consequences to other groups, strong resistance could be raised.

3.2.6. Sustainability

Sustainability may be encumbered by two different effects:

- Fading
  It should be carefully considered to which extent the impact of a planned measure can be expected to fade over time.
- Compensation
  As an example, the improvement of skills - if not flanked by measures also affecting attitudes - can easily lead to overconfidence, i.e. what could be called "misuse" of additional skills. Improvements of infrastructure may result in riding at higher average speeds. Many more examples - all of them based on the principle of risk compensation - could be mentioned here.

Hence, sustainable measures should be prioritised or, in case, a lack of sustainability should at least be taken into account when estimating effects, costs and benefits.

3.2.7. Transferability

The term "transferability" describes the potential of a measure having the potential to be applied in other places or on a wider scope. Efforts intended to solve a particular problem might neglect the issue of transferability. Nevertheless, if various measures are available to solve a single problem, the one which has the largest potential for trade-offs might be the most favourable one.

3.2.8. Institutional context

Road safety work by occasion might not be the most effective approach.

Many countries and regions have developed road safety programs. In general, road safety programs, visions and targets should consider issues of PTW safety. Alternatively, separated road safety programs, visions and/or targets specifically addressing the issue of PTW safety can be implemented.

Road safety programs normally have a very structured approach, which also includes a comprehensive process of prioritising. Details can be found within chapter 5 of this volume.

3.2.9. Post-implementation

Implementation of any measure should be flanked by implementing a suitable process of evaluation at the same time. Comprehensive planning of evaluation is particularly important, where the scope of implementation of a measure leaves no room for a control group, i.e. a simple ex-post analysis of effects is impossible. Sound assessment of the real impacts, hence, might have to include a comprehensive measurement and analysis of relevant factors of the untreated situation. The issues highlighted in the previous sections of this chapter should form the basis for planning of evaluation activities.

Acceptance should also be carefully observed, since supplementary measures (road user information, advertising, campaigning or enforcement) might appear to be necessary.

Long-term evaluation should be considered, where sustainability of a measure is questionable and the respective evaluation schemes should already be developed prior to implementation.

Evaluation should be carried out by neutral, independent and respectively qualified institutions.

Evaluation results should be used to adjust measures if recommended and necessary; and such results should also be made available regardless if a measure is successful or not. In macroeconomic terms, publication of failures might be more important than reports on successful measures, although such reports might not be very "popular". Learning from mistakes has always been a successful concept. It may be more efficient to improve a weak measure instead of running through the whole process of inventing new measures.

Quality assurance should be an issue when implementing a measure and can be considered the next step after evaluation. The post-implementation assessment process should identify criteria which should be considered for quality assurance.

3.3. Synthesis

3.3.1. Designing a “new” measure from scratch

As noted there are several factors that need to be investigated in order to design a measure targeting at improving PTW road safety. The focus of a measure should be well defined when considering the design of a measure. Measures that target more than one focus items may also be designed, however, their complexity increases. Following this the impact of the measure and its size should be estimated at an accurate level, and it goes without saying that the impact should be positive regarding road safety. If the measure improves road safety but at the same time reduces mobility or worsens environmental conditions the degree at which it affects each of the different items should be sought and a single impact factor should be decided. In addition to the impact itself – as safety measures are usually designed for a group of people not just individuals – the size of the impact or of the problem at which the measure targets needs also to be estimated.

Acceptance issues are of high importance as even if a measure is effective, if the riding (or driving) population at which it targets does not accept it the compliance rate will be low and hence the effectiveness of the measure will be lower than estimated. In addition, if the measure is not accepted by the riding (or driving) population the integration of this measure with other strategies should be considered. Such strategies include enforcement strategies or providing motives to riders (drivers) such as lower insurance costs. Still if a measure is effective but not accepted by administrative bodies – mainly those who should implement it (usually such reasons may include high cost measures providing low benefits, or low acceptance rates by an important population) – then the measures will not be implemented. Hence, cost-benefit issues – although probably not so politically correct – should also be considered. Once considering the cost and benefits of a measure, one should also include “hidden” costs that will make it unattractive. An example might be the cost of taxi rides by young people on a graduated licensing scheme which does not allow them to drive at night.

Sustainability of a measure is also important as it illustrates its effectiveness through time. If sustainability is low, certain strategies maybe considered in order to increase its sustainability with time. If no such strategies can be applied and sustainability is rather low, then it might be the case that implementing the measure is not recommendable. Last, transferability is also an important element as the same measure might or might not be implemented with the same success in different countries. This depends on several factors including the highway-code of the country, rider and driver training, population mentality, accident contributing factors etc. However, using the same “base” of a measure and altering specific characteristics of the measure in order to adapt it in such a way that it suits the needs of different types of nationality populations is important.

Last it is of crucial importance to be able and estimate the measure’s success. Hence, a method should be designed prior to implementation. If this measure allows for estimation of small groups and proves to be successful it can then be applied to the whole population. If such estimation is not possible, then the success of the measure should have been accurately estimated before implementation, as a before-and-after study might prove to be costly both in terms of actual costs but also and most importantly in terms of loss of lives.

Hence, to design a new measure from scratch all the aforementioned factors should be taken into account. Positive answers to all these factors indicate a potential successful measure; however, it might be the case that not all factors receive positive answers. It could be the case - depending on the type of factor that received negative feedback – that correctional actions or strategies are designed and implemented making the measure successful. It should be noted that for the design of these measures we must bear in mind the riding population needs and their resulting behaviour.

3.3.2. Designing a “new” measure taking into account previous experience

However, there are several other ways to design a “new” road safety measure with the aim to improve road safety without starting from scratch, but already having answers to at least some of the aforementioned elements. Previous experience is of great importance when it comes to the design of road safety measures. Failures of road safety measures for PTWs that were anticipated to be successful but were not, should be sought. Once ways to overcome those problems are adapted to this measure, this could be a “new” road safety measure with the potential to succeed.

Another way for designing a potential successful “new” measure involves best practices from other countries. As noted, transferability comprised an element that influences a measure’s success. Measures that have been found to improve PTW road safety in other countries could be used as a basis for the design of a “new” measure in another country. In particular, if the measure can be modified according to the specific needs of the riding/driving population it can be a successful “new” measure in several different countries.

In addition, specific road safety measures that have been proven to be successful for other types of vehicles (e.g. passenger cars) could be carefully modified in order to take into account the needs of the distinct movement and characteristics of PTWs and be potentially successful PTW road safety measures. Two specific sectors of such measures involve graduated licensing and ITS. Graduated licensing that can be adapted for PTWs in respect to specific bans (e.g. riding with pillion passengers, riding at night, riding at high speed roads, riding specific engine size bikes) and different other characteristics (e.g. riding experience in exposure terms or time) in the different licensing phases, might be a measure that is quite effective. In addition, new technologies should be sought. Most of them have been tested extensively in passenger cars or trucks but not in PTWs. The measures that seem to have a positive effect in road safety should be examined whether they can be adapted for PTWs taking into account the PTW distinct characteristics including vehicle dynamics (mainly related to the weight, size and stability), absence of separation between the rider and the road environment, rider mentality or motives etc. Such systems might be alerting ones (e.g. intersection warning system) or passive enforcement ones. A system belonging to the latter category could be a helmet reminder system, similar to the seat belt reminder system that all new cars are equipped with.

However, as noted in the previous section, the design of PTW road safety measures should first take into account PTW needs and riding behaviour (interacting with other road users, the environment or the vehicle). Hence, the system that was previously noted, which is the helmet reminder system, would be probably important and hence should receive attention only in countries where the wearing a helmet is mandatory by law and compliance is low (e.g. Greece). In countries where compliance to this law is quite high the investigation of this measure would not be necessary or even beneficial. Hence, the final “conclusion” is that there is no “one” answer for the issues involving PTWs. Their needs, their behaviour, societal issues are contributing factors that influence the measures that need to be designed and the appropriate strategic actions.

4. Discussion

Currently, there is an increase in PTW ownership, the number of returning riders and the PTW mobility, resulting to an increase on the usage of this particular road user population involving both commuting and leisure trips (Paulozzi et al, 2007; Jamson and Chorlton, 2009; Ministry of Transport, 2009; Haworth, 2012). This increase concerns both developing and developed countries (Haworth, 2012) and there are several factors behind the increase of PTW use. One is the increase of congestion in urban areas where PTW due to its size and hence distinct movement offers higher mobility (Lee et al., in press). This distinct movement mainly involves filtering/lane splitting, which in some countries/cities is allowed and in others tolerated from the respective authorities as it also increases the network's capacity (Sermpis et al., 2005; Spyropoulou and Sermpis, 2009). In addition, in several road charging city schemes (e.g. in Milan, London, Stockholm) PTWs are exempted from toll charges, which makes PTWs a more attractive transport mode for commuting purposes (Santos, 2004; Armelius and Hultkrantz, 2006; Rotari et al., 2010). These exemptions have resulted in a low but still steady increase within the years of the PTW (motorcycle and/or moped) fleet in London (MORI, 2004; TfL, 2005; TfL 2008). Economical crisis is anticipated to make PTW an even more popular mode. PTW ownership cost, gas/petrol costs and maintenance costs are substantially lower to those of a passenger car, making the PTW a more economic transport mode for specific purposes (Duffy and Robinson, 2004). For all the aforementioned reasons PTW ownership and use are expected to increase even more.

Together with the increase of the use of PTW, it should be taken into account that PTWs' are considered to be a vulnerable road user group as their accident and severity rates are significantly higher compared to those of a passenger car users (Phan et al, 2010; Saleh et al, 2010). Furthermore, the reduction of PTW fatalities during the last decade is significantly lower than the respective reduction of fatalities in all other vehicle types (OECD/ITF, 2010). Several countermeasures for road safety are being designed and implemented but the majority of those involve passenger cars or trucks. The existing high risk rates and the potential increase of the use of PTWs makes the design and implementation of countermeasures towards the reduction of PTW risk and severity rates of crucial importance.

For all the aforementioned reasons it is of vital importance to target the research of PTW safety and behaviour in a direction that leads to the design of successful road safety measures that will mitigate PTW accident and severity rates. This research has to be conducted from two points of view: first the point of view of the other road users' behaviour and then the point of view of the riders' behaviour, as in accidents where more road users than the PTW are involved it could be the case that their interaction is the primary reason for increased accident probability. In addition, it could be the case that not only the rider anticipates a different behaviour from the other road user than that exhibited but also the other road users anticipates a different behaviour from the rider than the actual one. For this reason, the point of view of both traffic and PTW experts is essential.

In this report, several "measures" (part C) with a potential to mitigate PTW risk rates have been described and analysed in order to allow for the identification of the most and least promising countermeasures. The scoring has been done by a large number of experts in the field of road safety. These experts have different backgrounds in terms of their expertise domains (psychologists, human factors specialists, engineers etc), nationality, experiences, and have also different mentality and perspectives. Hence, the scoring of the measures is quite subjective. In addition, a total score indicating the potential of each measure being a successful one was provided by FEMA to have a "formal position" from the point of view of the riders, who are also experts in the field.

It should, however, be noted that the need for such measures and their effectiveness is also dependant on how and where these measures are applied. In different countries road user mentality, traffic conditions, vehicle movement characteristics, the actual problems/needs of the riding population are different and hence important factors to be taken into consideration when designing and implementing a measure. For example, in Southern European countries, although it is mandatory to wear a helmet, the proportion of the law-abiding riders is rather low, especially for the rear riders and during the summer months when temperatures rise. In contrast, in Northern European countries law obedience is quite high. In this case the installation of a helmet reminder system either with warning or with intervening functionalities (i.e. the engine will not start if the helmet is off) would be quite beneficial for Southern Europe and not a priority for Northern Europe. Hence, the prevailing conditions in different countries must be taken into account when designing a measure. Transferability of countermeasures between countries is always possible however; in several cases it might be ineffective (unless other types of strategies such as enforcement are also designed to support the measure) or even unnecessary (if there are no needs for this particular measure). Hence, the expert's scoring might also be affected by his/her nationality.

Generally, the design and proper implementation of such measures are not as simple and more detailed knowledge is required on the PTW accidentology domain. In most cases the calculation of risk rates does not involve the inclusion of exposure data (e.g. PTW kilometers) in the formulae, providing misleading results. Hence, actions towards the collection of reliable PTW exposure data well disaggregated for the various demographic, road environment and vehicle characteristics are necessary. In addition, appropriate data revealing the contributing factors leading to an accident where a PTW is involved have not been extensively collected. In-depth accident studies have been performed but they are well fewer than those for passenger cars. The first main steps of PTW in-depth accident studies were made by McLean et al (1979) and Hurt et al. (1981). Still there are some recent studies (2BESAFE, MAIDS) where accident in-depth studies on PTW have been performed; however the available data is still not sufficient to provide a complete picture of the PTW accident phenomenon.

Accident in-depth studies provide identification and quantification of the human (and human interaction) errors and the non-adaptation of riders to adverse road environments (infrastructure, pavement), in cases where anticipatory or correctional behaviour can be achieved to avoid an accident. However, the reasons, behind these findings should also be identified. In order to achieve this, behavioural studies on PTW riders and the interaction of PTW riders and other road users have to be carefully designed and implemented in order to collect the necessary data. This can be achieved with a range of methods and tools – some of which were deployed within the framework of 2BESAFE project – including driving simulators where the environment includes PTWs, riding simulators, Naturalistic Riding Studies (NRS), other verbal methods including questionnaires and focus group discussions and laboratory experiments. For example there is lack of knowledge on PTW movement characteristics and dynamics; only two rather small scale NRS compared to several large scale Naturalistic Driving Studies (NDS) and Field Operational Tests (FOTs) for passenger cars have been undertaken In addition, there is little knowledge on riders' aims, motives, risk attitudes, perception, anticipation and awareness. It is only on 2011 that the first pan-European study on PTW attitudes took place (Sartre 4 project[3]). Methods for collecting that type of data – looking at riders at a microscopic level – have been applied in 2BESAFE some at a pilot level and others at a more advanced one, but still behavioural data of PTWs in order to actually identify the related causational factors is still scarce.

The 2BESAFE project was designed is such a way so as to examine PTW behaviour and safety in an efficient manner – taking into account the time and budget constraints that a project of such nature has. Initially, accident research took place both at a macroscopic and microscopic (in-depth studies) manner. The resulting findings along with previous related literature findings formed a basis for the design of methods, tools and the inclusion of specific characteristics for the design of behavioural studies. In addition, several of the designed methodologies to examine rider behaviour comprise "novel" methodologies that can form the basis for the investigation of PTW rider perceptions, attitudes and riding behaviour at the same degree or at an even more complex or large scale one.

The results of accident studies also specified the particular needs for certain types of countermeasures. On the other hand, the findings of behavioural studies provided some insight on riders' perceptions, attitudes and riding behaviour, which was also used for the definition of the riders' needs and the evaluation of specific countermeasures. Hence, a high number of possible road safety measures has been defined and evaluated highlighting the most and least promising measures that can contribute in improving PTW road safety.

The highest number of popular measures depicted from the expert evaluation (both expert and FEMA) include measures that involve road infrastructure. A great number of measures scored highly and those measures were considered to be of high implementation priority in EU. For example measures including guidelines on road design, the performance of road safety audits (RSA) and road safety inspections (RSI) were largely supported. In respect to pavement conditions, road surface testing and reduction of roadway debris also received high scores. In general, the key issue that involved the high ratings of infrastructure measures is that road design, maintenance and operation is performed in a

[3] SARTRE - Social Attitudes to Road Traffic Risk in Europe, see http://www.attitudes-roadsafety.eu/

way that PTW dynamics and characteristics are not considered, resulting into making the road environment itself a contributing accident factor in a higher extent that it might be for other types of vehicles. However, the majority of the proposed measures to improve the self-explanatory and forgiving nature of roads received either low or conflicting scores, with the exception of specific types of guardrails (under-ride barriers for guardrails and guide posts made of flexible material. This indicates the need to “discover” additional measures for these two categories, as such measures are usually less costly and better accepted by the public. Another type of measures that got high scores involved post accident care. Measures including improving emergency and post-injury services and acquiring particular knowledge on how to deal with certain types of riders’ injuries that need specific care. In addition almost all measures related to road safety data and data collection received great support by experts and FEMA. Such measures include improvement of data collection, road conflict investigation, in-depth analysis of PTW accidents, naturalistic riding studies and identification of accident black spots. The interaction of PTWs with other vehicles which is considered to be a contributing accident factor was also considered as the measure involving other road users’ responsibilities to riders also scored high.

On the other hand there were several measures that were not considered to benefit PTW riders at all receiving rather poor scores. Specific measures that were classified under the road infrastructure category did not receive high scores from experts (although they did receive high scores from FEMA) mainly due to the high costs involved or the risk compensation that riders were anticipated to demonstrate which could reduce or even the eliminate the anticipated improvement on PTW road safety. An example of the first category is the provision of full paved shoulders and of the second the maintenance of roadway during roadwork. Measures on driver education, licensing and testing received high, medium and low scores depending on the examined measure. For example defining the legal regulations for obtaining a PTW licence providing initial rider training, organising workshops for young moped riders and providing practical training for novice riders were favoured amongst experts, whereas the graduated license scheme received diverse evaluations. The possibility of being provided access to certain PTW classes for people with a driving license was considered unbeneficial and also risky. There were several measures related to the vehicle (PTW) systems such as safety belts, adaptive cruise control (which received the lowest score) the implementation of which is not considered beneficial in any way, except for the design of future break systems which scored highly. The definition of speed limits for PTW’ was also considered to be ineffective, as it was considered to be of a discriminating measure. Measures involving traffic in town and regulations/laws received in general diverse scoring whereas the notion of shared space (already implemented mostly in the Netherlands) was not considered a measure that would provide any benefit.

There were also several diversions between the experts’ rating and the FEMA ratings. An example of such measures involves the traffic in urban areas and the respective regulations such as filtering and lane splitting. FEMA’s score was quite high as such measures improve PTW mobility, whereas the experts gave a low scoring mainly due to safety concerns. A category of measures which was considered promising by experts but not at all by FEMA involves PTW conspicuity; examples being the mandatory use of headlights, having automatic headlamps on (AHO) and recommendations when riding at night including reflective clothing or strips. For the majority of such measures the standpoint of FEMA is that they object to such measures because they infringe on the freedom of road user and that safety-conscious riders already rely on their judgment to decide when their comfort and safety requires actions related to conspicuity. However, the adaptive front lighting system received high scores from both “sides”. Last, the category of road safety education and campaigns received medium or low scores from experts in several cases by high scores from FEMA experts, as was expected, except for showing shocking films concerning motorcycle safety which according to expert and FEMA views should not be implemented. Indicatively, the measures involving educational brochures and using community collaboration to promote motorcycle safety received low scores from experts but high from FEMA. Generally, the evaluation results of several measures were different between the experts’ and FEMA’s point of view. This difference highlights the need for closer cooperation between researchers and riders. An issue to be further investigated is the comparison between the accident risk perceived by the rider and the actual accident risk.

Still, it should be noted that further research is required in order to be able to suggest potentially successful PTW road safety measures and implement them. What the researchers need to have in mind are the needs of the riders, their characteristics (riding behaviour, cognitive performance, mentality, acceptance, motives etc), their interaction with the elements comprising the road network (other road users, the road environment and the actual PTW) and the way “things work” in each country.

Part B - Institutional Organization of Road Safety

"Institutional Organization of Road Safety" aims at providing a basis for the implementation of safety measures on all fields of road safety. Measures in this category of the SUPREME project are related to the general organizational framework, visions, targets, and strategies, provision and allocation of financial resources, and tools and strategies for the selection and implementation of measures. Activities in this area are for the most part integrated in the political and administrative systems of the countries." This is the description of "institutional organization of road safety" within the SUPREME project[4].

In other words, institutional organization of road safety may be considered the backbone infrastructure for all road safety activities. It determines the frame conditions.

Institutional organization includes three main elements:

- Road safety vision
- Road safety program
- Road safety target

SUPREME has defined a road safety vision to be "description of a desirable state in the future, based on a theory of how the different components of the traffic system interact or must interact". Typically, a road safety vision contains a long term goal, either qualitative or quantitative, but without a particular timeframe for implementation.

Road safety targets typically state interim goals on the way towards implementing a road safety vision. Targets are quantitative, they address performance indicators:

- Output (e.g. number fatalities, injuries, collisions)
- Contributing factors (e.g. rate of seatbelt wearing, travel speeds, market penetration of certain safety equipment)
- Contributing activities (e.g. level of enforcement)

A road safety program should both include a road safety vision as well as a set of targets. Beyond that, it includes a set of particular measures considered suitable to contribute to reaching the targets and successfully modify the transport system into what is outlined by the respective road safety vision.

The common ground for vision, target and program is the need for public acceptance and commitment, which requires highest level political support. Some reports fulfil these criteria in a way, being supported at high political level, but are not officially implemented at governmental level. Such reports are mainly statements of single organizations or consortia; they may be called "position reports", "discussion reports", "guidelines" or "policy reports". Many stakeholders in the field of PTW have created such reports, which in aim and content may be quite similar to a road safety program.

Some of the following initiatives do not fit into this categorization, forming another approach. Two of the reports are technical guidelines, which define technical provisions towards PTW safety, which to a certain extent may also be legally binding. These reports are, or at least have the character of technical standards.

5.1. Road Safety Visions

Vision Zero

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[4] SUPREME: Summary And Publication Of Best Practices In Road Safety In The Member States. Thematic Report: Institutional Organisation Of Road Safety, Alena Erke, TØI (Institute of Transport Economics, Norway). See http://ec.europa.eu/transport/road_safety/pdf/projects/supreme.pdf

In 1997, the Swedish Parliament adopted the Vision Zero, a new road safety policy based on four principles:

- Ethics: human life and health are paramount; they take priority over mobility and other objectives of the road transport system;
- Responsibility chain: The providers, professional organizations and professional users are responsible for the safety of the system. The users have the responsibility to follow rules and regulations. If the road users fail to follow rules and regulations, the responsibility falls back on the providers of the system;
- Safety philosophy: humans make errors; road transport systems should minimize the opportunity for error and the harm done when errors occur;
- Driving mechanisms for change: providers and enforcers of the road transport system must do their utmost to guarantee the safety of all citizens and each of the participants should be ready to change to achieve safety.

Vision Zero is estimated to achieve a possible reduction in the number of deaths by a quarter to one third over a ten-year period and so touches the topic of motorcycle safety.

http://publikationswebbutik.vv.se/upload/1723/88325_safe_traffic_vision_zero_on_the_move.pdf

This idea of Vision Zero has already been put into practice in Norway: The Vision Zero Motorcycle Road is a nine-mile stretch of RV 32, a highway in Telemark County, southwest of Oslo. Telemark Road Authority engineers Jan Petter Lyng and Bjørn R. Kirste designed the highway with features recommended by motorcyclists including amongst others crash barriers fitted with a sub-rail, safely placed signposts and more forgiving terrain running along the side of the road.

Road Safety Lillehammer – Towards Vision Zero

Between 2003 and 2006, a national demonstration project of Vision Zero was implemented in the Lillehammer region, called “Traffic Safety Lillehammer – Towards Vision Zero”. A demonstration road was included in the project consisted of streets with heavy traffic and a large number of pedestrians and cyclists, typical villages (also with substantial tourist traffic), a two-lane, high-standard road, as well as country roads in the form of local roads.

Some main tasks of the project were to solve an existing problem of frequent accidents on the demonstration road, to implement measures against the most serious accidents, to use measures in the project that address the entire traffic system, including the road, vehicles and road users, to include a mixture of well-known and new measures for accident prevention and to establish a communication centre focusing on road safety and promoting the project both locally and nationwide.

The main challenges of the project were to render visible different courses of action that can be taken in accident prevention, to demonstrate what can be achieved within a reasonable economic framework, to provide space for new perspectives and encourage research institutions to be engaged in the project, to enhance awareness of road safety issues and provide useful information about the project to visitors and to the population, both locally and nationwide.

In the project, safety measures in vehicles were demonstrated by offering test rides in vehicles equipped with ISA (Intelligent Speed Adaption), alcohol ignition interlocks and computerized logs that register driving patterns.

http://www.nordicroads.com/website/index.asp?pageID=83

5.2. Road Safety Programmes and Targets

Towards a European Road Safety Area: Policy Orientations on Road Safety 2011-2020

In July 2010, the European Commission published a document with respect to the policy orientations on road safety up to 2020. It aims to provide a general governance framework and challenging objectives which should guide national or local strategies. In line with the principle of subsidiarity, actions should be implemented at the most appropriate level and through the most appropriate means. In the framework of these policy orientations, the European Commission considers that the three following actions should be undertaken as a priority:

- the establishment of a structured and coherent cooperation framework which draws on best practices across the Member States, as a necessary condition to implement in an effective manner the road safety policy orientations 2011-2020,
- a strategy for injuries and first aid to address the urgent and growing need to reduce the number of road injuries,
- the improvement of the safety of vulnerable road users, in particular motorcyclists for whom accidents statistics are particularly worrying.

In general, the policy orientations target the road users' behaviour (education, training and enforcement), the vehicles as well as the infrastructure. With regard to PTW riders' safety, a wide range of actions is listed including amongst others the promotion of passive safety devices, targeted enforcement strategies (speed, drink driving, helmet use, tampering, riding without a proper PTW license) and the improvement of the awareness of PTW riders by other road users.

http://ec.europa.eu/transport/road_safety/pdf/com_20072010_en.pdf

National Agenda for Motorcycle Safety – U.S. Department of Transportation

Published in 2000, the National Agenda for Motorcycle Safety of the National Highway Traffic Safety Administration aims at identifying the most important issues on improving motorcycle safety. Based on the indentified measures, recommendations for policy-making are formulated.

The agenda is structured according to the Haddon-Matrix, so the main issues covered are research on motorcycle safety, human and social factors, motorcycle factors and environmental factors. The Human Factors contain rider skills, types of impairment and protective equipment. On the post crash side of the Haddon Matrix, the issues crash research, education/training and evaluation are listed. The social factors describe measures on enforcement, peer rider pressures and other attitude related issues. The vehicle section is about motorcycle design and vehicle modifications. The section about environmental factors deals with Intelligent Transport Systems (ITS), different road safety measures and with the topic EMS (Emergency Medical Service) response. The agenda is closed down with a summary of recommendations.

http://www.nhtsa.dot.gov/people/injury/pedbimot/motorcycle/00-nht-212-motorcycle/toc.html

The Government's Motorcycling Strategy – DfT

In February 2005, the Department for Transport (DfT) published the UK Government's Motorcycling Strategy. The principal aim of this strategy is to 'mainstream' motorcycling, so that all the organizations involved in the development and implementation of transport policy recognize motorcycling as a legitimate and increasingly popular mode of transport. To get the full involvement of motorcycling groups representing the views of industry and users, the Advisory Group on Motorcycling delivered input like their Report to Government, published in August 2004.

The theme for the Strategy is to facilitate motorcycling as a choice of travel within a safe and sustainable transport framework. Thus, its aim is to make motorcycling a safe, enjoyable experience for those who choose this mode of transport. This means taking account of the motorcyclists' needs, promoting safety measures and mainstreaming motorcycling, so that its needs are considered as fully as any other transport mode, in the development of transport policy. The strategy includes actions to be taken by the Central Government as well as by stakeholders, such as manufacturers, retailers and user groups to pursue. The Government's Motorcycling Strategy is being taken forward by the National Motorcycle Council (NMC), which includes representatives of motorcycle user groups, manufacturing, retailing and training industries as well as local government and Department for Transport officials.

Since the Motorcycle Strategy was published, the NMC has been working on revising the action plan contained in the 2005 Strategy. In July 2008, a new action plan for the Government's motorcycling strategy was released, which updated and revised the actions in the 2005 strategy. It shows where the 2005 actions have been completed and includes some new actions.

http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/roads/vehicles/motorcycling/overnmentsmotorcyclingst4550.pdf/

Motorcycling in Scotland – Scottish Motorcycling Community

In 2007, the Scottish Executive issued new guidance on motorcycling related issues, which should be taken into account by Roads Authorities and Regional Transport Partnerships when preparing Local and Regional Transport Strategies. It has been prepared by the Scottish motorcycling community. The guidance covers issues relating to the role, which PTWs can play in overcoming social exclusion, reducing urban traffic congestion and reducing transport emissions. The guidance also encourages the development of strategies to reduce casualties and improve safety and security, particularly through the design and implementation of motorcycle friendly road safety schemes and infrastructure.

The main topics are the policy for motorcycles, the Scottish road network, congestion and motorcycle parking. Furthermore, it contains strategies for the safety of motorcyclists and a summary of IHIE's guidelines for motorcycling.

http://www.scotland.gov.uk/Publications/2007/07/Motorcycling/Q/Page/1

National Road Safety Strategy of the Czech Republic 2004-2010

Following the EU Road Safety Action Plan, the Czech Republic targeted to half its road deaths by 50% up to 2010, which means to cut number of persons killed to 650 persons until 2010. The Minister of Transport of the Czech Republic announced many times that road safety was one of his very high national policy priorities and that he personally supported all efficient measures to be taken to improve road safety in the Czech Republic.

The expert group under chairmanship of the Ministry of Transport with co-operation with other ministries and agencies, including the Ministry of Public Health, Ministry of Interior, Transport Research Centre (CDV), the Police Forces, started to draft the strategy. The final version of the strategy was submitted to the Government Meeting in April 2004 and was approved as the official governmental (national) strategy on combating road traffic accidents up to year 2010 in the Czech Republic.

As results from the analysis and following a SWOT analysis, the critical facts in terms of PTW safety are identified as follows:

- Low level of legislation acceptance by road users
- Low level of legislation exactness
- Serious consequences of road accidents caused by speeding
- Serious consequences caused by not giving way
- Serious consequences caused by alcohol
- Low usage of passive safety devices
- Dangerous traffic environment, especially in urban areas

The main goal of the Strategy was the decrease of the total number of accidents and their consequences caused by speeding, by not giving way and by the influence of alcohol. Furthermore, the severity of road accident consequences should be decreased by increasing the wearing rate of restraint devices, by improving the protection of vulnerable road users, by providing a safe road environment, by improving post accident care and by increasing the road users' respect to the legislation.

http://www.fondzebra.ru/doc/Westknow/CZ/CZ_-_National_Road_Safety_Strategy_of_the_Czech_Republic_-_2004.pdf?PHPSESSID=89af50a7a009f39d1ec6ae64a8bf4832

Spanish Strategic Road Safety Plan for Motorcycles and Mopeds

In 2007, the Spanish Government, counting on the active participation of the sector's main actors (manufacturers, dealers, insurers, local administrations, user associations, etc.), had prepared the Strategic Road Safety Plan for mopeds and motorcycles which was then launched in 2008.

The plan deals with the present situation of motorcycling in Spain concerning registration and accident numbers as well as "psychosocial profiles" of motorcyclists and develops recommendations for solutions and measures. Furthermore, the Safety Plan discusses the organizational system of Road Safety Management in Spain.

The main goal of the Safety Plan is the reduction of the number of accident casualties. Therefore, motorbikes shall be prepared for safe driving (access, training), high accident rate scenarios shall be minimized (traffic management, adapting infrastructures, equipment of vehicles), risky driving shall be fought (rising awareness, preventive actions, sanctioning) and mitigating measures shall be adopted (infrastructures, assistance, motor biker equipment).

This program turned out to be huge success. PTW rider fatalities, which almost double between 2003 and 2007 were reduced to level of 2003.

http://www.svmc.se/upload/SMC%20centralt/Dokument/rapporter/PTW-Road-Safety-Plan-Draft-English.pdf

http://www.motocicletasyseguridadvial.com/default.aspx

Austrian Road Safety Program 2002 to 2010 and 2011 to2020

For the first time in Austria, a programme was created, which contained a structured approach for traffic safety work and presented an overview of possible steps to reduce accidents. The basis of this work resulted from the scientific as well as interdisciplinary work of the Austrian Road Safety Board (KFV). The primary objective of this effort was the reduction of deaths and injuries to be achieved by effective implementation and financing, securing political and social acceptance and cost-effectiveness.

Issues covered by this program are

- running awareness raising campaigns through the whole duration of the road safety program using personal contact with riders.
- developing particular enforcement models for speed offences, adopting speed to visible distance, driving close to the right edge (mopeds) and noise pollution
- supporting EuroNCAP efforts towards pedestrian friendly car fronts, which are beneficial for all vulnerable road users (therefore also for PTW riders).

This national guideline was published in 2004 by the Austrian Federal Ministry of Transport, Innovation and Technology. KFV had produced and lobbied road safety programs for decades, but none was implemented officially by administration of government. The overall process of implementation was a combination of lobbying and results by a technical working group. The program was periodically reviewed and redrafted.

This first Austrian Road Safety Program did not particularly target PTW riders; however, there were some measures included addressing and/or affecting safety of PTW use in Austria.

http://www.bmvit.gv.at/en/service/publications/downloads/brochure_roadsafety2010.pdf

The Austrian Road Safety Programme 2011 to 2020 was launched after the first program had expired its period. The programme tries to implement the so-called "Safe System Approach" describing a safe traffic system for all road users. It contains a list of 250 safety measures which are classified into 17 action fields (e.g. road safety education, driver licensing, enforcement, pedestrians, bicyclists, motorcyclists, post-accident-care, level crossings).

With respect to PTW riders, the programme especially targets the following subjects:

- improvement of driver licensing and training
- effective anti-tampering measures

- programmes to increase the awareness on safety helmet use
- road safety education concerning other road users' responsibilities to riders
- promotion of protective equipment
- increased implementation of passive safety systems (especially ABS)
- rehabilitation of accident hotspots

http://www.bmvit.gv.at/service/publikationen/verkehr/strasse/sicherheit/downloads/vsp2020.pdf

Non-governmental Austrian Road Safety Programme – Austrian Motorist Association

In 2011, the Austrian Motorist Association ÖAMTC published its own road safety programme. Unlike the Austrian road safety programme released by the Federal Ministry for Transport, Innovation and Technology, this programme does not represent the government's point of view. In fact, this brochure lists the Austrian Motorist Association's core topics concerning traffic safety for the period from 2011 to 2020. The topics are classified into the categories behaviour, infrastructure, vehicle, emergency services, legal framework conditions as well as traffic policy. With respect to PTW riders, there is an emphasis on post licensing training, driver education, self-explaining roads, anti-tampering measures, stricter enforcement measures, and on the obligatory implementation of advanced braking systems.

http://www.oeamtc.at/media.php?id=%2C%2C%2C%2CZmlsZW5hbWU9ZG93bmxvYWQlM0QlMkYyMDExLjA1LjAyJTJGMTMwNDM1NTc3My5wZGYmcm49MDM2OF8xMSUyMEJyb3NjaCVGQ3JlX1ZlcmtlaHJzc2ljaGVyaGVpdF9sb3cucGRm

Australian Road Safety Strategies

Australia has a national road safety strategy (2001-2010) and a national road safety action plan (2009-2010). States and territories also have their own strategies. These contain bland statements about what governments plan to do to improve road safety.

In the national road safety action plan, it says the following for motorcyclists:

- Implement public education programs focused on the greater risk faced by motorcyclists and measures to mitigate this risk.
- Ensure that motorcycle-specific issues are taken into account in the design and construction of new roads and improvements to existing roads, including maintenance and selection of safety treatments, particularly on popular motorcycle routes.
- Promote to riders the safety advantages of ABS, linked braking systems and traction control in motorcycles, and encourage the motorcycle industry to increase the availability of motorcycles with these features.
- Consider options for a best practice graduated licensing system for novice riders.
- Examine feasibility of introducing minimum standards and a national rating system for protective clothing for motorcyclists.

There is also a special action plan called "First Action Plan: 2008 – 2010" for Victoria. It was published by the Victorian Government's new 10 year road safety strategy "Arrive Alive 2008 – 2017" and sets the following targets for motorcyclists:

- Undertake awareness raising campaigns to increase safe road user practices by drivers and riders and highlight to all road users the extreme vulnerability of motorcycle riders
- Support motorcycle trainers and retailers in encouraging the use of protective clothing.
- Enforcement:
  - Improve strategic enforcement that is location and season specific, with a focus on high risk motorcycle routes.
  - Better enforcement through regulatory or legislative change to require clear identification of motorcycles.
- Infrastructure:

    - Trial barrier protection devices to improve motorcycle safety, and revised design and maintenance procedures.
    - Treat motorcycle blackspot locations, blacklengths and popular touring routes.
    - Undertake a risk based assessment of the road network from a motorcyclist's perspective
- Promote consumer take-up of anti-lock braking systems, integrated braking systems and other safety features.
- Licensing:
    - Improve motorcyclist and scooter rider training and strengthen the licensing process, through measures including development of a motorcycle hazard perception training tool.
    - Continue the promotion and distribution of the RideSmart CD ROM training product to novice riders in order to accelerate riding and higher order skills.
    - Introduce new regulations for learner and probationary motorcyclists in Victoria through the introduction of a new Learner Approved Motorcycle Scheme (LAMS).
- Research and data:
    - Investigate simulation and computer modelling to better understand motorcycle crash risk and injury.
    - Undertake an enhanced motorcycle crash investigation study to increase understanding of the factors that contribute to the incidence and severity of motorcycle crashes.
    - Investigate enhancing the emergency response to motorcyclists involved in crashes.
    - Investigate improvements to the protective qualities of helmets.
    - Conduct a motorcycle exposure study to increase understanding of crash risks facing motorcyclists.
    - Investigate means by which returning and non-regular motorcyclists are required to maintain rider skills at an appropriate level.

National road safety strategy:

http://www.atcouncil.gov.au/documents/atcnrss.aspx

National Road Safety Action Plan:

http://www.atcouncil.gov.au/documents/files/ATC_actionplan0910.pdf

Victorian Road Safety Strategy:

http://www.arrivealive.vic.gov.au/strategy/victorias_road_safety_strategy.html

Arrive Alive Action Plan:

http://www.arrivealive.vic.gov.au/action_plans/action_plans_for_2008_to_2017.html

Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers 2009–2013

This Action Plan is designed to set a new strategic direction for the use of PTWs in Victoria over the time period from 2009 to 2013, taking an integrated approach to PTW safety and transport. It mainly targets four areas for action:

- increasing knowledge and understanding of PTW riding and crashes
- ensuring that PTWs are given appropriate recognition in transport policy and planning
- improving rider awareness, skills and knowledge
- encouraging greater use of safer motorcycles and scooters, equipment and protective clothing by riders.

The plan recognizes the critical priorities of improving safety on the roads, reducing congestion and moving towards a more sustainable and lower emissions transport system. Besides, it contains actions which have to be undertaken from 2009 to 2011, whereas new set of actions for 2012–2013 will be developed. It has been conducted in consultation with a range of stakeholders, including input from members of the Victorian Motorcycle Advisory Council.

http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/Motorcycles/VictoriasRoadSafetyAndTransportStrategicActionPlanForPoweredTwoWheelers.htm

5.3. Road Safety Guides and Studies

Vulnerable Riders – ETSC

In 2008, the European Transport Safety Council (ETSC) published the report "Vulnerable Riders – Safety implications of motorcycling in the European Union". It contains general data about collisions involving PTWs and recommendations for vehicle measures (primary safety measures: braking system, conspicuity, speed limiters; secondary safety measures: helmets, protective clothing, airbags and leg protectors, PTWs with protective cages; measures involving other road users: blind spot mirrors, A-pillar design, side protection on trucks), road user behaviour (rider training, rider licensing, driver training, enforcement), road design and traffic engineering (curves, intersections and roundabouts, road safety features, road building and maintenance, signs and road markings, road safety audit and inspections, use of bus lanes by PTWs, advanced stop lines for PTW). Finally, there is a list of 16 clear recommendations, concerning the following subjects: general, human factors, vehicle and equipment and road infrastructure.

http://www.etsc.eu/documents/ETSC_Vulnerable_riders.pdf

A European Agenda for Motorcycle Safety – FEMA

With its European Agenda for Motorcycle Safety (EAMS) published in 2007, the Federation of European Motorcyclists Associations (FEMA) intends to contribute to the road safety debate, providing stakeholders with the motorcyclists' expertise and real needs. The document emphasizes that motorcycles and motorcyclists have different characteristics from other vehicles and their drivers. Besides, it identifies the specific needs of motorcyclists that must be addressed along with those of other road users. In order to significantly improve motorcycle safety in Europe, FEMA uses the concept of the Haddon Matrix, which is based on four important aspects:

- Human
- Vehicle
- Environmental
- Social

The EAMS is aimed at providing legislators, decision makers, and all stakeholders dealing with motorcycle safety, with a brief summary of why motorcycle accidents happen from a rider's perspective and recommendations on how to improve motorcycle safety in some selected areas of particular concern.

http://www.fema-online.eu/index.php?page=european-agenda-for-mc-safety

Integration of needs of moped and motorcycle riders into safety measures – PROMISING

The deliverable 3 "Integration of needs of moped and motorcycle riders into safety measures" is one of the six volumes of the European research project PROMISING, on the promotion of mobility and safety of vulnerable road users. The research was carried out by a consortium of European partners, which was co-ordinated by the SWOV Institute for Road Safety Research.

The report, which was released in 2001, gives a review of legislation and of statistical information on the use and safety concerning mopeds and motorcycles for Western European countries. Also a review of the literature on safety problems and measures is given. In detail, measures concerning training and experience, legislation, handling, braking, lighting, design and maintenance of the roads, traffic rules, perception of PTWs, protection of riders as well as data collection and research are presented. Based on these measures, the report concludes with a list of recommendations.

http://ec.europa.eu/transport/roadsafety_library/publications/promising_deliverable_3.pdf

Guide for Addressing Collisions Involving Motorcycles – TRB

In 1998, the American Association of State Highway and Transportation Officials (AASHTO) approved its Strategic Highway Safety Plan, including strategies in 22 key emphasis areas that affect highway safety. Each of the 22 emphasis areas includes strategies and an outline of what is needed to implement each strategy.

Over the last few years the National Cooperative Highway Research Program (NCHRP) has been developing a series of guides to assist state and local agencies in reducing injuries and fatalities in targeted areas. The guides correspond to the emphasis areas outlined in the AASHTO Strategic Highway Safety Plan. Each guide includes a brief introduction, a general description of the problem, the strategies respectively countermeasures to address the problem, and a model implementation process.

Goal 11 in the Strategic Highway Safety Plan is to improve motorcycle safety and increase motorcycle awareness. Thus, it tries to increase the awareness of highway agencies concerning the unique characteristics of motorcycles and their needs on the roadway. The corresponding NCHRP guide, which was published in 2008, includes strategies intended to reduce the number and severity of motorcycle crashes. Strategies include not only operation of the motorcycle, but also ways of improving both the travelled way and roadside to be more ‘motorcycle–friendly.’

The objectives for improving motorcycle safety and increasing the awareness of the unique characteristics of motorcycles include:

- Incorporate motorcycle-friendly roadway design, traffic control, construction, and maintenance policies and practices
- Reduce the number of motorcycle crashes due to rider impairment
- Reduce the number of motorcycle crashes due to unlicensed or untrained motorcycle riders
- Increase the visibility of motorcyclists
- Reduce the severity of motorcycle crashes
- Increase motorcycle rider safety awareness
- Increase safety enhancements for motorcyclists
- Improve motorcycle safety research, data and analysis

http://www.trb.org/Publications/Public/Blurbs/A_Guide_for_Addressing_Collisions_Involving_Motorc_160626.aspx

Barriers to Change – Position Paper EuroRAP

EuroRAP (European Road Assessment Program) is an association of motoring organizations and road authorities, which has established a system to measure the safety of roads. The association released a position paper on motorcycles and crash barriers in 2008. Hence, the position paper represents the result of a two year review of available evidence and debate on the issues of motorcyclists and safety barriers. Crash barriers – that routinely save the lives of car occupants but can cause traumatic death and injury to bikers – account for up to one in every six rider road deaths, and can cause five times the severity of injury. "In collisions with crash barriers, bikers are 15 times more likely to be killed than car occupants. Safe road design – incorporating barriers, road markings and safer surfaces – has been proven to cut deaths and injuries for all road users by one third" (from EuroRAP website).

The report finds clear evidence to justify new and immediate guidance on the design and positioning of crash barriers, showing road engineers where motorcycle friendly systems should be fitted at new sites, and retro-fitted at existing high-risk sites.

http://www.eurorap.org/news_item?search=y&ID=200

Road Safety Toolkit – iRAP, gTKP & World Bank Global Road Safety Facility

The Road Safety Toolkit provides free information on the causes and prevention of road crashes that cause death and injury. Building on decades of road safety research, the Toolkit helps engineers, planners and policy makers develop safety plans for car occupants, motorcyclists, pedestrians, bicyclists, heavy vehicle occupants and public transport users. For each group of road users, measures – including their costs, treatment life and effectiveness – concerning safer road treatment, safer vehicle treatment as well as safer people treatment are listed.

The Road Safety Toolkit is the result of collaboration between the International Road Assessment Programme (iRAP), the Global Transport Knowledge Partnership (gTKP) and the World Bank Global Road Safety Facility. ARRB Group provided expert advice during the Toolkit's development.

http://toolkit.irap.org/default.asp?page=roaduser&id=6

The Accident Risk of Motorcyclists – TRL

In 2004, the Transport Research Laboratory (TRL) published a study with the objective to explore and quantify the interacting influences which determine motorcyclist accident (and casualty) liability. The data analysis showed that trends in casualties can be broadly explained in terms of changes in numbers and sizes of motorcycles and the mileage they cover. The survey included questions on riding behaviour which covered traffic and control errors, speeding behaviour, stunt riding, use of safety equipment, pleasure derived from motorcycling, relative assessment of skill, beliefs about accident causation and riding style. Self-reported errors most consistently predicted accident liability. Many of the errors are linked with a careless, inattentive riding style, failure of hazard perception and missing control skills. The errors are linked to underlying riding styles which tend towards violation behaviour because they depart from the good normative rules of safe riding. Riding style, getting pleasure from motorcycling, and liking for speed predict behavioural errors that predict accidents.

The report makes a number of recommendations for improving the safety of motorcycle riders. Although it is not a road safety program, this report gives some important information on how to encounter the particular risk of PTW riders and should therefore be considered within this chapter. It gives the following recommendations:

- Young, inexperienced riders should continue to be a target group for safety interventions as they are at high risk and they can be reached by the training/testing/licensing system.
- More experienced motorcyclists develop improved riding skills and they continue to seek fun and excitement which can cause overestimation of one's own capabilities and lead to accidents. The advanced motorcycling organizations should promote a careful, safe and responsible riding style.
- Errors tend to be linked to an "enthusiastic" riding style. Driver training shall not only focus on control skills but also on insight into risk and self-limitations.
- Although there was no evidence that people returning to riding after a long break are at increased risk, consideration should be given to developing training and educational material for these riders and to encouraging them to participate.

http://www.dft.gov.uk/rmd/project.asp?intProjectID=10086

Road Infrastructure Safety of Powered Two-Wheelers – ERF – IRF BPC

The European Union Road Federation (ERF), the Brussels Programme Centre of the International Road Federation (IRF) is a non-profit association which coordinates the views of the European road sector and acts as a platform for dialogue, information and research on mobility issues. It is signatory to the European Road Safety Charter and undertakes a series of initiatives with the scope of helping reduce the number of fatalities on European roads.

In 2009, it published a Discussion Paper on the road infrastructure safety of PTWs. It shows how PTWs suffer from increased levels of risk on European road infrastructure, but that this same level can be considerably reduced by applying simple and cost-effective infrastructure measures which will yield immediate beneficial effects. In terms of safer road engineering, these measures can be assigned to two categories: "Prevention" comprises manholes, road design (self explaining roads), maintenance, road horizontal markings, speed calming measures, roadside clutter, regular audits, sweeping excess material and better signalization; "mitigation" includes road restraint systems as well as road design (forgiving roads).

Concerning concrete measures, the authors suggest the following:

- Training and awareness

- Improve infrastructure
- New European Norms
- Raise awareness

http://www.erf.be/media/position_papers/PTW%20Discusssion%20Paper_Final_IF.pdf

Motorcycle Accidents – AIB

The Danish Road Traffic Accident Investigation Board (AIB) in 2009 completed its sixth investigation report. The theme "Motorcycle Accidents" was chosen because motorcycle accidents represent a growing traffic safety problem. Thus, the AIB conducted an investigation to highlight the reasons for motorcycle accidents and establish a starting point for a goal orientated initiative for motorcyclists' safety. In total, 41 motorcycle accidents were investigated in terms of injury severity, other party's involvement, collision types, road conditions and motorcyclist's experience. It was found out that the most consistent accident types were:

- Motorcyclist crashes in a curve
- The overtaking motorcyclist collides with a left-turning motorist
- The motorcyclist collides with an on-coming, left-turning car
- Motorcyclists driving forward collide with motorists from a side road

In the course of the investigation, a range of recommendations aimed at road users and various authorities were put forward. Overall, AIB's analysis shows that it was very much the behaviour of road users which caused the accidents. The current general experience is that it is much harder to change the behaviour of road users than the design of roads and vehicles.

In the end, the following conclusions are drawn:

- Motorcyclists themselves can contribute to traffic safety
- The second party can contribute to motorcyclists' safety
- Increased police enforcement will ensure that more motorcyclists observe the traffic laws
- Safer roads can prevent accidents and make accidents less serious
- New technical requirements must be introduced for motorcycles

http://www.hvu.dk/pdf/Rapp6_UK_AIB_dec09_til_nettet.pdf

IHIE Guidelines for Motorcycling – Institute of Highway Engineers

The IHIE Motorcycling Guidelines support the UK Government Motorcycling Strategy which aims to 'mainstream' motorcycles into core transport policy. The individual chapters set out practical guidance for transportation professionals on providing a safer environment for motorcycles, mopeds and scooters. The scope of these guidelines is defined within the topics:

- Policy
- Travel plans
- Traffic engineering
- Parking
- Maintenance
- Road safety campaigns
- Traffic calming
- Road Safety Audit

http://www.motorcycleguidelines.org.uk/

Motorcycle Crash Countermeasures – Monash University Accident Research Centre

In 1996, the Monash University Accident Research Centre published a report on motorcycle crash countermeasures. It includes a literature review as well as an implementation workshop. The literature review has examined many of the proposed countermeasures designed to either prevent crashes or reduce rider and pillion passenger injuries in the event of a motorcycle crash. In addition, the need for improvements to the effectiveness or methods of implementation of current countermeasures has been assessed. The countermeasures discussed include those which reduce the risk of a crash occurring (improvements to conspicuity, motorcycle rider training, awareness training for car drivers, enforcement and licensing initiatives, zero BAC, restrictions on carriage of pillion passengers, restrictions on off-road riding by young riders, improvements to motorcycle braking, improvements to rider field of view, engine capacity and power restrictions, modifications to the road environment) and those which reduce the severity of injury in crashes (helmets, lower limb protection, airbags and protective clothing). The implementation workshop discussed the advantages and disadvantages and barriers to implementation of the recommendations of the literature review.

www.monash.edu.au/muarc/reports/muarc087.html

eSUM – (European Safer Urban Motorcycling)

eSUM is a collaborative project involving the motorcycle industry and local authorities from some of Europe's principal motorcycling cities with an aim to identify and develop measures to make urban riding safer. The project started in Mai 2008 and was completed by November 2010.

One of the project's work packages, which was carried out by Transport for London, identifies good practice projects which contribute to reducing urban PTW fatalities. Therefore, a literature research was undertaken to locate and access PTW safety projects. This was followed by a questionnaire distributed to organizations involved in PTW safety requesting information on any successful projects. In total, over 200 projects from across the world were assessed for their potential to contribute to a reduction in urban PTW casualties. Those projects, which were considered successful, were chosen and listed in a so-called "Good Practice Guide", which includes 107 projects in total. The Good Practice Guide forms one of the most comprehensive lists of PTW safety measures currently available, which also provides well-structured and detailed information on the measures, in many cases also including effectiveness figures.

The projects were classified into 6 themes.

- Training and Awareness
- Highway Features and Policy
- Targeted Enforcement
- Specific Highway Remedial Measures
- PTW Design and Protective Equipment
- 'Softening' the Highway Infrastructure

http://esum.eu/gpg.html

ROad SAfety – CIDAUT

ROSA Project (ROad SAfety for motorcyclists), project co-funded by the European Commission, coordinated by the Spanish Research and Development Center in Transport & Energy CIDAUT and with the collaboration of Spanish Directorate General of Traffic (DGT), International Motorcycling Federation (FIM) and MotoGP, has had as main objective to reduce European motorcyclist accident rate through the elaboration and dissemination of a "handbook of the best practices in regards to Powered Two Wheeler (PTW) safety" to the highest possible audience. ROSA run over 12-month period (2010-2011) and its main targets were: Building a state-of-the-art in PTW safety through the operation of an Expert Group; Organising 5 Workshops across the EU - alongside the celebration of 5 MotoGP Grand Prix held in the EU with a view to introducing best practices in PTW safety and gathering intelligence from stakeholders and Elaborating a "European Handbook on Best Practices in PTW Safety" and its dissemination mainly via information stands at 11 MotoGP Grand Prix taking place in the EU in 2010. The availability of a Handbook on PTW safety to the organised motorcyclist community and related stakeholders and an increased awareness about PTW safety from the general public has constituted a major development for advancing EU policies in the motorcycle sector.

The "Good Practices Handbook" was structured in six epigraphs:

- Infrastructure (for the 23 problems that were detected in this epigraph, 48 good practices were listed. 5 out these 48 practices were known to be effective from a scientific point of view).
- Vehicle (for the 9 problems that were detected in this epigraph, 53 good practices were listed. None of them were known to be effective from a scientific point of view).
- Human Factor (for the 10 problems that were detected in this epigraph, 71 good practices were listed. 21 out these 71 practices were known to be effective from a scientific point of view).
- Motorcyclist Clothing (for the 12 problems that were detected in this epigraph, 41 good practices were listed. 10 out these 41 practices were known to be effective from a scientific point of view).
- Enforcement (for the 5 problems that were detected in this epigraph, 9 good practices were listed. 3 out these 9 practices were known to be effective from a scientific point of view).
- Education-Training (for the 4 problems that were detected in this epigraph, 36 good practices were listed. 15 out these 36 practices were known to be effective from a scientific point of view).

This project is complementary to the previous one “eSUM project” due to eSUM focused only on urban PTW fatalities whereas ROSA focused on all the PTW fatalities (urban or outside urban areas).

http://ec.europa.eu/transport/road_safety/pdf/projects/rosa.pdf

Motorcycle Accident In-Depth Study – ACEM

The Association of European Motorcycle Manufacturers (ACEM) with the support of the European Commission and other partners conducted an extensive in-depth study of motorcycle and moped accidents during the period 1999-2000 in five sampling areas located in France, Germany, Italy, Netherlands and Spain. The methodology developed by the Organization for Economic Co-operation and Development (OECD) for on-scene in-depth motorcycle accident investigations was used by all five research groups in order to maintain consistency in the data collected in each sampling area.

A total of 921 accidents were investigated in detail, resulting in approximately 2000 variables being coded for each accident. The investigation included a full reconstruction of the accident; vehicles were inspected; witnesses to the accident were interviewed; and, subject to the applicable privacy laws, with the full cooperation and consent of both the injured person and the local authorities, pertinent medical records for the injured riders and passengers were collected. From these data, all the human, environmental and vehicle factors, which contributed to the outcome of the accident, were identified.

To provide comparative information on riders and PTWs that were not involved in accidents in the same sample areas, data was collected in a further 923 cases. The collection technique was specifically developed to meet the circumstances of this study and is commonly referred to as an exposure or case-control study. This exposure information on non-accident involved PTW riders was essential for establishing the significance of the data collected from the accident cases and the identification of potential risk factors in PTW accidents.

The most important findings are as follows:

- The object most frequently struck in an accident was a passenger car. The second most frequently struck object was the roadway itself.
- Travelling and impact speeds for all PTW categories were found to be quite low (most often below 50 km/h).
- The cause of the majority of PTW accidents collected in this study was found to be human error. The most frequent human error was a failure to see the PTW within the traffic environment, due to lack of driver attention, temporary view obstructions or the low conspicuity of the PTW.

- The use of alcohol as well as riding PTWs without having the required license increased the risk of being in an accident.

The data collected during this study represents the most comprehensive in-depth data currently available for PTW accidents in Europe.

http://www.maids-study.eu/

Motorcycle Safety in Northern Ireland – Right To Ride

"Motorcycle Safety in Northern Ireland – The Rider's Perspective" is a document that contains the expertise of motorcyclists. It aims to be a starting point for discussion and debate to develop a strategy for motorcycle safety in Northern Ireland incorporating all stakeholders (motorcycle community, individual riders, clubs, groups and associations). The issues within this document are linked to the priorities for motorcycle safety identified during the International Transport Forum/OECD workshop on Motorcycling, held in Lillehammer, Norway in June 2008.

http://www.righttoride.co.uk/

Guidelines for PTW-Safer Road Design in Europe – ACEM

ACEM was founded in 1994 and represents the major motorcycle manufacturers in the European Union (either European or producing in Europe), as well as twelve associations at a national level. As part of their contribution to the EU target, ACEM initiated the idea of creating an integrated European roadway design handbook for PTWs. This handbook, which was published in 2006, contains recommendations for a safe infrastructure.

PTWs differ in their use of the road in a number of ways from other vehicles and riders have different needs. Predictable road geometry, good visibility, obstacle free zones and good quality road surface with high levels of skid resistance are some major examples. While important for all road users, they are essential for PTWs.

This handbook describes the specific needs of riders and contains guidelines for those responsible for road design and road maintenance. It includes recommendations and examples from all over Europe. The main topics are: road design and traffic engineering (bends, intersections, roundabouts, obstacles alongside the road, elements on or in the roadway, building/ material usage), road maintenance, traffic management (signs, road markings, bus lanes and advanced stop lines), parking issues, safety campaigns and road safety audits.

http://www.acem.eu/media/d_ACEMinfrastructurehandbookv2_74670.pdf

Motorrad fahren – auf sicherer Straße! – ADAC & DVR

The German automobile club ADAC (Allgemeiner Deutscher Automobil-Club e.V.) and the German Road Safety Council (Deutscher Verkehrssicherheitsrat – DVR) have appointed a task force to identify appropriate measures to minimize the motorcyclists' risk. Thereby, the ideas and recommendations are mainly based on the report "Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken" published by FGSV[5].

In order to compile a working basis and guidebook for policymakers, the brochure "Motorrad fahren – auf sicherer Straße!"[6] was published. This brochure can also be used by accident commissions to identify motorcycle accident blackspots on rural roads. In this paper, especially underride guards are recommended to increase the motorcyclists' safety. Besides, it is suggested that road safety inspections as well as audits should also focus on the motorcyclists' needs.

www.dvr.de/download/broschuere_motorrad-fahren.pdf

[5] Forschungsgesellschaft für Strassen- und Verkehrswesen, *http://www.fgsv.de/*, see description below

[6] Motorcycling - on a safe road!

5.4. Standards

Guidelines for Improvement of Road Safety on Typical Motorcycle Routes – FGSV

The German title reads "Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken". This paper, which was released in 2007, was prepared by the German Forschungsgesellschaft für Straßen- und Verkehrswesen (FGSV, i.e. a non-profit association of engineers from public administration, science and economy. Main task: elaboration of technical standards related to road construction). Most of all, it contains tangible measures for improving road safety along accident-prone motorcycle routes. With the help of the report, some common PTW accidents should be avoided or at least the consequences of the accidents should be mitigated. Thus, the guideline targets the number of conflicts/accidents and the PTW rider injury severity. Especially, its focus is on PTW accidents with other vehicles and on accidents in consequence of turn off-maneuvers at intersections.

To find appropriate measures, an in-depth analysis of PTW accidents was carried out. After this in-depth accident investigation, potential causes for the most common PTW accidents were worked out and measures for the special needs of motorcyclists were developed. These measures concern amongst others road design and enforcement measures (markings, posts, road surface, roadside, motorcycle-friendly passive protection devices, enforcement).

http://www.fgsv.de/

Recommendations for the Improvement of Motorcycle Safety – FSV

Organizational context, purpose and contents of this initiative are very similar to the example from Germany described above.

In Austria, the Austrian Association for Research on Road – Rail – Transport FSV (Österreichische Forschungsgesellschaft Straße – Schiene – Verkehr) publishes RVS (Guidelines and Specifications for Roads), which are instructions and regulations representing the technical state-of-the-art in a specific field. In August 2010, the RVS 02.02.42, which was developed by a working group consisting of experts in various fields, on recommendations for the improvement of motorcycle safety was released. This standard presents several measures, which can be introduced on PTW accident-prone (mainly rural) routes with respect to the available financial means, to increase the safety of PTW riders. Therefore, the ten most frequent PTW accident types on rural roads as well as possible accident causes are listed and measures to minimize the accident risk are described.

The measures presented in this paper are divided in two categories: “Active” measures are those which reduce the number of PTW accidents by influencing the traffic behaviour of PTW riders. They include infrastructure (road markings, guide posts, traffic signs), enforcement, organizational and remedial (elimination of sight barriers, improvement of pavement friction, rearrangement of routing, elimination of obstacles) measures. The second category is called “passive” measures and comprises actions which diminish the consequences of an accident. Thus, this category is made up of road restraint systems.

http://www.fsv.at/

MC Safety – Norwegian Road Administration

Published in 2004, this handbook on PTW-safety is the result of the cooperation between motorcyclists and central road authorities. It should be used as a guide and reference for all people working on planning, construction, operation and maintenance of roads and traffic systems. It also addresses PTW riders to provide a better understanding of risks involved and accident causes. The authors formulate problems with respect to PTW safety concerning new roads, roads that are reconstructed (conflict with other considerations, curves and roadside, intersections, guardrail, bridges, road markings, road installations) and existing roads (roadway cleaning, friction, patching asphalt pavements, asphalt paving, road markings, guardrail improvement, signing, tunnel illumination, dew in tunnels, work area traffic safety). Besides, they give ideas and solutions for those.

http://arkiv.nmcu.org/publ/vegdir_handbok245/handbook245e.pdf

5.5. Funding Safety Measures

Introducing a Motorcycle Safety Levy

A Motorcycle Safety Levy was introduced in Victoria in 2002 in recognition of the vulnerability of motorcyclists and their over-representation in road trauma statistics. The Levy is added to the Transport Accident Commission insurance premium on motorcycles of 126cc capacity and over, and is included with motorcycle registration renewals. The Levy enables the implementation of a program of road safety initiatives that address the key issues causing trauma to motorcyclists but do not meet funding criteria under State and Federal road safety programs. A strategic framework to guide expenditure of Levy funds was developed with input from Monash University Accident Research Centre, motorcycle safety professionals, and members of the Victorian Motorcycle Advisory Council (VMAC). One of the most important initiatives to be funded by the Levy is road improvements at blackspot locations. Since the implementation of the Levy alongside the “Arrive Alive!” Road Safety Strategy, motorcyclist fatalities have decreased in Victoria, whilst increasing across the rest of Australia.

http://www.arrivealive.vic.gov.au/initiatives/safer_road_users/the_motorcycle_safety/the_motorcycle_safety_levy.html

As special projects are funded by the motorcycle safety levy, safer road conditions are provided at known motorcycle crash sites. Besides, projects can be financed which aim to increase rider understanding of the risks involved and to develop more safety conscious and skilled riders. Furthermore, increasing the awareness of drivers to the difficulties experienced by motorcyclists (e.g. at intersections) reduces the likelihood of conflicts and helps preventing collisions.

Part C - Specific Measures On Powered Two Wheeler Safety

6. Road Infrastructure

Improving road infrastructure offers one of the best ways to reduce collisions and injury for PTWs, already from the early stages of its design. Planners need to ensure, in fact, that when the design of the road is finalized, this encompasses all the latest safety measures for all the types of users, be it heavy good vehicles, passenger cars or PTWs, bicycles as well as pedestrians. Furthermore, the infrastructure also needs to be designed so that it is self-explaining, as various studies have demonstrated the increased risk of accidents on road sections presenting unexpected features or layout.

6.1. Organisational Measures

Guidelines on Road Design

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★★	Implementation	★☆☆☆☆
Safety impact	★★★★★	Acceptance	★★☆☆☆
Efficiency	★★★★☆	Sustainability	★☆☆☆☆

Several guidelines containing definitions of major criteria which have to be taken into account by a road designer have been published. These guidelines imply recommendations about both the design and the verification of the roads already constructed.

Typical construction guidelines discuss issues as the designing and installation of roadside systems (traffic control, traffic guidance facilities, vehicle restraint systems, etc.).

Examples:

Examples for overall guidelines on Road Design are the guideline of the Finnish Road Administration, which was implemented in 2004, and the Austrian RVS[7]. A special issue is to provide more details in RVS 02.02.42, motorcycle safety. This part of the guideline was published in August 2010.

In order to increase PTW's safety, the European Commission declares in its policy orientations up to 2020 that on-going efforts to better adapt road infrastructure should be continued.

ACEM (2006). Guidelines for PTW-safer road design in Europe, p.12

Amongst others, guidelines concerning PTW friendly road design are also listed in IHIE's Guidelines for Motorcycling (see chapter 3) as well as in ACEM's Guidelines for PTW-safer road design (see chapter 5.2).

IHIE (2005). IHIE Guidelines for motorcycling - improving safety through engineering and integration, pp.27-35

ACEM (2006). Guidelines for PTW-safer road design in Europe, pp.25-60

In the PROMISING project, it is pointed out that road construction authorities are focused mainly on four-wheeled vehicles, although driving dynamics are not as problematic as for two-wheelers. In this sense, the road construction should not be in contradiction to the requirements of vulnerable road users like PTWs.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.145

Part 15 of Australia's "Austroads Guide to Traffic Engineering Practice" concerning Motorcycle Safety (AP-11.15/99) is often used by traffic engineers in Australia to design the roadway to enhance rider safety. It is an advisory, not a mandatory publication. The guide includes an overview of motorcycle accidents, describes the principles of a safe road environment and the safe design of roads, describes motorcycle characteristics, discusses the safety needs of motorcyclists and provides guidelines for

[7] The RVS-Guidelines and Specifications for Roads are obligatory instructions and regulations representing the technical state-of-the-art in a specific field.

good practice. The good practice guidelines cover the road surface, road layout and alignment, delineation, signing, lighting, roadside furniture, roadwork and maintenance.

http://www.onlinepublications.austroads.com.au/script/Details.asp?DocN=AR0000007_1004

Guidelines from Norway: The Norwegian Public Roads Administration has produced a design handbook for highway engineers designed to improve PTW safety: “MC – sikkerhet. VEILEDNING.Håndbok 245”. www.vegvesen.no/_attachment/61487/binary/14194

Guidelines from France: “Prise en compte des motocyclistes dans l’aménagement et la Gestion des infrastructures 2000”.

http://www.certu.fr/catalogue/p494/PRISE_EN_COMPTE_DES_MOTOCYCLISTES_DANS_L'AMENAGEMENT_ET_LA_GESTION_DES_INFRASTRUCTURES/product_info.html?language=en&PHPSESSID=6aa145dbad82b5c6cbfe98b692eb942e

Guidelines from Germany: The ifz (Institut fűr Zweiradsicherheit e.V.) produced in 2003 these guidelines: “Motorradfreundlicher Straßenbau. Motorradfreundlicher. Anforderungen an Planung, Bau und Betrieb von Straßen”.

http://www.ifz.de/Publikationen/Praxis6-Druck.pdf.

Guidelines from the Netherlands: “Handboek gemotoriseerde tweewielers. Een handreiking voor veilig wegontwerp, wegonderhoud en beheer. 2003”.

http://www.crow.nl/nl/Publicaties/publicatiedetail?code=190.

Guidelines from United States of America: This guide created by the US Transport Research Board’s National Cooperative Highway Research Program (NCHRP) provides guidance on strategies that can be employed to reduce crashes involving motorcycles on US roads.

http://144.171.11.107/Main/Public/Blurbs/160626.aspx

On the other hand, the involvement of motorcycle groups during road design has been probed to be effective. For instance, Road Safety Professionals in Northamptonshire considered that a substantial reduction of motorcyclist deaths and serious injuries were due to low cost safety measures suggested by riders. Casualties on 20 routes regularly used by motorcycles and considered as 'red routes' decreased by 56% after launching a road safety partnership and implementing educational, engineering and enforcement measures.

http://www.northamptonshire.gov.uk/

Beneficiaries:

This kind of guideline is addressed to all vehicle classes and targets road design. There are special issues that aim explicitly at the reduction of motorcycle collisions.

Clear definition of the problem

The needs of PTW riders and other road users significantly differ from each other.

The measure aims at either including issues of PTW riding in general guidelines on road design or set up separate guidelines on road design particularly addressing PTW-related issues.

Typical issues are: road geometry, forward visibility, intersection design, road surface quality, etc.

Size of the problem

Vision Zero delivers a suitable approach: Roads should be designed in order to provide a safe environment for mobility to all road users. Road users - i.e. also PTW riders - are obliged to use roads in a safe way. However, if road users from some particular reason fail to use the road safely, the responsibility falls back to the infrastructure provider. In other words, this problem covers more or less all roads and implies necessity to generally include issues of PTW riding in road design, construction and maintenance.

Scientific Background

There is evidence that several PTW accidents are caused due to road geometrical characteristics. At the same time, several road design guidelines are not appropriate for the dynamics of PTW movement. Hence, modified guidelines that take into account the movement characteristics of PTWs would improve PTW road safety.

Several guidelines upon which roads are designed are not appropriate for PTW movement. In this respect, if new roads are constructed or existing ones modified according to new guidelines (if this can be done) PTW riders will ride at a road environment which considers their movement dynamics and needs as well.

Implementation, Transferability

Technically, it is very easy implementing such guidelines. Already existing papers offer a wide variety of potential measures which have been successfully applied.

The critical issue is adaptation to local, regional or national frame conditions. PTW safety concepts have to be set up based on the typical way, road are built in the target area. Modal split, rider population, climate and many other parameters have to be considered in the process of selection and priority-setting.

Political constraints due to financial reasons are a typical barrier to implementation of guidelines on road design.

Expected Impact

It will reduce PTW accidents and accident severity. The degree differs and is dependent on different countries, and different types of the road geometry (bends, intersections etc).

In 2BESAFE, in-depth analysis of road geometry accident causation factors took place.

Risk compensation is expected to happen especially for common users of a specific road. Once a rider is aware that the road design contains risk for a PTW rides in a more careful way, however, if road design does not contain risk for a PTW or is forgiving then the rider might ride more aggressively.

Acceptance

Accident statistics and scientific evidence of accident the factors of which are bad road design can persuade legislative bodies that the absence of guidelines for road design considering PTWs is an important problem.

One can show a cost-benefit analysis that indicates that the development of appropriate guidelines for PTWs and its implementation in new roads and black spots is beneficial compared to possible future accidents. In addition, such bodies will also gain popularity as actions towards improving road safety are always welcome by the public (voters).

Setting up standards and guidelines on road design is normally an activity which is hardly noticed by the general public, however, as examples mentioned above show, it is highly recommendable to integrate riders' representatives in the process of setting up guidelines.

Sustainability

The development of new guidelines is unlikely to fade. on the contrary, setting up guidelines is an element of creating sustainable effects. Guidelines might, however, need to be updated, once new elements occur (new road surfaces, different vehicles, change of rider population, etc).

As for many other organisational measures, sustainability is not only an issue of the process itself. The safety impact of guidelines will be just as good as the recommendations provided within the guidelines as well as range and quality of its correct practical application.

Costs and benefits

Road infrastructure is possibly the area where most information is available on efficiency of measures. This is not surprising considering that road construction and maintenance is extremely expensive compared to other measures. However, there is also long list of low-cost measures available, which are selected by efficiency criteria.

There was no information available about costs and efficiency of guidelines themselves with respect to PTW safety.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Both drivers and riders have certain requirements and expectations in infrastructure.

Infrastructure construction and maintenance requires huge investment. As a matter of course, such investment should be well-planned.

These facts would indicate a top priority to this measure; however, the experts also consider difficulties of implementation. The description above provides no explanation for the low rating on sustainability, where a predictable, homogeneous, self-explaining and forgiving network (which normally is the primary goal of guidelines on infrastructure) would be expected to be a most sustainable measure.

Road Safety Audit

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★★☆

Road Safety Audits (RSA) are independent inspections of road schemes for new road projects and for the reconstruction of existing roads. The goal is to find possibilities to optimize road design in order to enhance road safety already during the planning phase, assuming that such measures can be identified based on the blueprints of new roads or reconstruction projects and a successful first attempt is cheaper than crash costs and later improvement. For the Trans-European Road Network (TERN), allocation of RSA is mandatory as of December 2010 according to the "Infrastructure Directive"

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0096:EN:NOT

The practical application of RSA is very different throughout the European Union Member States. RSA is a formal process consisting of checks of the plans for construction or reconstruction projects, typically in two or three steps. In many countries, auditors use checklists for RSA procedures. Currently, some of these checklists and procedures hardly consider PTW riders' needs.

Examples:

This measure is recommended for example by the transnational ETSC (European Transport Safety Council) guideline for vulnerable riders. ETSC explicitly recommends improving RSA procedures towards more consideration of PTW riders' needs.

ETSC (2008) Vulnerable Riders, pp.22-23

Besides, the European Union Road Federation, the Brussels Programme Centre of the International Road Federation calls for specific road safety audits which take into consideration the point of view of PTW users and assess the infrastructure's level of safety, as foreseen in the recent Directive on Road Infrastructure Safety Management (2008/96/EC).

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.10

In the UK, the Department for Transport and the Institution of Highways and Transportation commissioned the creation of a Road Safety Audit 'interactive checklist', which is a web application for use by road safety professionals.

http://www.lancspartners.org/safetychecklist/policy.asp

Beneficiaries:

According to the European "Infrastructure Directive" (2008/96/EC), RSA is only mandatory for the TERN. Nevertheless, many countries apply RSA also on the rural and local networks. All groupd of riders may benefit from application of RSA.

Figure 5: Road Safety Audit[8]

Clear definition of the problem

Road planning mistakes may create dangerous spots for PTW-riders, e.g. inappropriate alignment and road geometry design (radii, curvature, crossfall …), dangerous visibility situations or intersection design. RSA is a formal process which aims at detecting such errors already during the planning phase of road (re)construction. For being most efficient also in terms of avoiding PTW accidents, procedures have to include issues of PTW safety.

Size of the problem

Depending on the road type, estimations are between 5 to 10% of the crashes. Some areas, especially mountainous the percentage of the road design influences are even higher.

Scientific Background

Road safety audit is a well proved practice and procedure.

Some EU projects like Ripcord-Iserest or Pilot4Safety and several national projects and practical examples (e.g. UK, Ireland, Australia, etc.) show the positive effects.

The problem can be targeted to nearly 100%.

Directive 2008/96/CE on road infrastructure safety management applies only to TEN-T road network – but secondary roads are the core problem.

Implementation, Transferability

The only considerable barrier to include issues of PTW safety in RSA is proper training and re-training of auditors. Checklists, training manuals are available and can easily be adopted.

Expected Impact(s)

It is almost impossible to measure the impact of a procedure like RSA in terms of crash counts or crash costs. Such an evaluation would measure the quality of the measures identified by RSA instead of measuring RSA's effectiveness or efficiency per se. Winkelbauer (2006) presented a number of studies on effects of RSA. He found that the overwhelming majority of measure identified by RSA are highly efficient and that RSA is capable of detecting most of the problems. However, these results are valid for application of RSA in general. It may easily be assumed that properly trained and experienced auditors will perform as well in terms of PTW accidents. Application of RSA is not expected to create any negative impact.

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[8] Source: http://www.tfhrc.gov/focus/nov06/03.htm, 3 Aug. 2009

Acceptance

Including issues of PTW riding within application of RSA methodology will hardly affect anyone but road authorities. Since public money is widely involved in building roads, this is widely a question of political decisions.

Sustainability

RSA is an instrument of improving sustainability. If there is any weak point, it might be a lack of continuous retraining of auditors, which might cause decreasing quality of their work.

Costs and benefits

Several projects try to answer that point. The benefits are proven, the financial benefits are strongly depending on the project size, road type and safety measurements. The best estimations are done in software tools for accident prediction models (e.g. system of VTT). The costs are simply to count; more critical is a monetary estimation of the safety effects.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Due to a well known, very good relation between costs and benefits, highest priority should be given to consider issues of PTW riding within road safety audits.

Road Safety Inspection

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★☆☆

Road Safety Inspections (RSI) are a part of the safety management for existing roads. A RSI is a systematic assessment of the road standard of an existing road network. Special attention is given to hazards, environmental risk factors and roadside features. Like RSA, it is mandatory in Europe from December 2010. As for RSA, the guidelines, the commonly used procedures and checklists hardly consider any issues of PTW rider safety and should be improved accordingly. Therefore, motorcyclist high risk sites and high risk sections should be identified. Next to motorcyclist high risk sites, the identification of the most popular motorcycle touring routes, which normally involve one day touring circuit (often including a key attraction), scenic location and good motorcycle riding experience (mountainous and/or curvilinear alignment), should be carried out, too. The complete length of a route should be inspected in terms of surface, roadside hazards, sightlines, signage (and delineation) and speed.

The primary focus of the improved RSI is to locate motorcycle safety problems and to determine countermeasure treatments (generally on-road treatments) to improve motorcycle travel and safety on the particular route, including amongst others:

- Minor areas of pavement resurfacing,
- Repair, sealing and delineation of shoulders on high risk curves,
- Repairs to broken road edges,
- Improvements to roadside drainage to prevent water/loose material washing onto pavement,

- Improved and consistent delineation along the entire route,
- Installation of appropriate signs,
- Improved visibility/sightlines to intersections and other potential hazards.

Example:

This measure is recommended for example by the transnational ETSC guideline for vulnerable riders. As for RSA, ETSC recommends paying more attention on PTW safety needs within RSI.

ETSC (2008). Vulnerable Riders, pp.22-23

In the course of a RSI, a check of the route concerning PTW riders' needs and safety should be performed at accident blackspots and on routes with increased PTW accident risk.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.10

Furthermore, ERF – IRF BPC calls for specific road safety inspections which take into consideration the point of view of PTW users and assess the infrastructure's level of safety, as foreseen in the recent Directive on Road Infrastructure Safety Management (2008/96/EC).

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.10

Beneficiaries:

Please see conclusions for RSA.

Clear definition of the problem

In the life cycle of a road the safety relevant factors are changing in a negative way. Road surfaces get damaged, polished and slippery. Road design (curvature) of the past decades and not appropriate any more. Plantings influence the visibility. Roads need to be maintained and checked regular to ensure a continuous safety level.

Size of the problem

Depending on the road type and area, up to approximately 15% of PTW crashes are caused by poor quality of the road infrastructure (alignment and road surface). Combinations of critical parameters (skid resistance, unevenness, negative crossfall, etc.) result in dangerous spots for PTW-riders.

Scientific Background

RSI is a well proved practice and procedure. Some EU projects like Ripcord-Iserest or Pilot4Safety and several national projects and practical examples (e.g. UK, Ireland, Australia, etc.) show the positive effects. The problem can be targeted to nearly 100%. Directive 2008/96/CE on road infrastructure safety management applies only to TEN-T road network – but secondary roads are the core problem for PTW-riders.

These statements apply to RSI in general. It may be assumed that they are applicable toconsideration of PTW issues within RSI to the same extent.

Implementation, Transferability

Again, this statement does not address RSI per se, it is about including issues of PTW safety in RSI. It is not much of an effort to adopt RSI checklists and train auditors. Model checklists and training manuals are available and can easily be adopted.

Expected Impact(s)

It is almost impossible to measure the impact of a procedure like RSI in terms of crash counts or crash costs. Such an evaluation would measure the quality of the measures identified by RSI instead of measuring RSA's effectiveness or efficiency per se. Winkelbauer (2006) presented a number of studies on effects of RSA. He found that the overwhelming majority of measure identified by RSI are highly efficient and that RSI is capable of detecting most of the problems. However, these results are valid for application of RSI in general. It may easily be assumed that properly trained and experienced auditors will perform as well in terms of PTW accidents. Application of RSI is not expected to create any negative impact.

Acceptance

Including issues of PTW riding within application of RSA methodology will hardly affect anyone but road authorities. Since public money is widely involved in building roads, this is widely a question of political decisions.

Sustainability

RSI is an instrument which addresses typical problems of sustainability (wear and tear of roads, overgrowing vegetation, etc). If there is any weak point in the methodology, it might be a lack of continuous retraining of auditors, which might cause decreasing quality of their work.

Costs and benefits

Benefits are proven, the financial benefits are strongly depending on the project size, road type and safety measurements. The best estimations are done in software tools for accident prediction models (e.g. system of VTT). The costs are simply to count, more critical is a monetary estimation of the safety effects. Respective figure were analysed by Elvik et al (2009, pp1043ff) and Winkelbauer (2006).

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Due to a well known, very good relation between costs and benefits, highest priority should be given to consider issues of PTW riding within road safety audits.

Black Spot Management

Expert Assessment			
Overall		★★★★★	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

The phenomenon of accident clusters has been recognized for many years and there is considerable evidence showing that the identification and treatment of such sites with low-cost engineering remedial measures can be extremely cost-effective. Approaches to accident cluster reduction includes Single Site, Mass, Area, and Route Action plans. Of the four basic strategies, the potential for accident reduction using simple low-cost remedial measures at single hazardous sites is particularly high. Treatment of locations involving such single sites, are generally known as 'black spots'. In countries with limited experience of accident remedial measure work, this straightforward approach is likely to be the most effective.

Defining a Blackspot is not straightforward. Given a range of approaches to data collation and variations in areas and locations under consideration, investigating bodies differ in defining what constitutes a Blackspot. Resources available are also a consideration. Sites chosen for further investigation may not necessarily be selected on the number and severity of accidents reported alone. Sites can be chosen on ranking or 'weighting' of accident severity or traffic flow. Traffic flow based criteria requires a reliable and constant source of traffic data. Reliable, long term traffic counting information is difficult and expensive to acquire and depending on how it is used bias the accident analysis towards sites with low traffic flows. Other factors reflected in accident weighting schemes can include type of road user injured, severity of injury and accident costs. Length of road may be a parameter in rural area considerations.

Example:

The Barcelona municipality Road Safety team developed in collaboration with local police and technicians a procedure for registering road accidents. To identify black spots, these raw data were geo-referenced and then, those locations having more than ten accidents per year were identified. The Risk Zones Application (RiZA) application enables police and traffic managers to propose remedial actions and once they are implemented, they are recorded by the system resulting in a feedback. Thereby, the accidents recorded in the next period are used to assess the impact of the various actions implemented.

The system started by handling small-scale interventions (changes to signal phases, small traffic management interventions, etc.) and many of these were found to be extremely cost-effective. To help the traffic management designer, the system provides menus of actions ranked by the proven performance.

VicRoads, within its Strategic Motorcycle Safety Program in Victoria, Australia, also launched a targeted motorcycle blackspot improvement program, which "was expected to yield robust safety benefits if valid site identification procedures and effective treatment techniques could be identified. ... The Motorcycle Blackspot Program was established early in the Levy program and earmarked for approximately 75% of the original estimated funds. ...

The estimated BCR of all projects in the Motorcycle Blackspot Program was 5.2 based on the calculated benefits derived for different treatments types implemented under Blackspot programs for all road users. That equates to over $30 million in crash cost reductions derived from less than $6 million expenditure. More importantly this is sparing riders and the community from serious road trauma. Preliminary investigations suggest that this estimate could be conservative. An evaluation based on the first 50 treated blackspot sites indicated that there was a 37% reduction in rider casualty crashes after adjusting for exposure by using control sites from around the relevant local government area. If these findings could be applied over the life of the road treatments and continued across more recently implemented blackspot improvements, the benefits of the program would be considerably greater than 5.2 times the cost. However, these findings are preliminary and will require an additional 18 months of data in order to establish statistically reliable results." (Dale, 2006)

Beneficiaries:

In terms of accident reduction and prevention, considerable success can be achieved with low-cost engineering safety improvements directed towards treating accident clusters at localized sites. Thus, based on accurate data about the accident location, the total number of accidents can be reduced.

Clear definition of the problem

Providing good data is collected it is relatively easy to identify geographical locations where accidents are more clustered than others. However, this does not in itself explain the causes of the collisions or highlight the remedies to prevent future crashes.

Clustering of collisions could occur simply as a result of exposure, for example if lots of young motorcyclists attend the same college and use the same route this may appear more ‘dangerous’ than others, but this could be a direct consequence of the large number of inexperienced riders who use it and have no bearing on the road design or environment.

The challenge is to identify genuine ‘black spots’ where highway design measures can make a genuine difference.

Size of the problem

There is a wide range in the expertise and proficiency of different local and road authorities across Europe at collecting, analyzing and acting upon data to remedy black spots.

Scientific Background

Data has been collected for many years and comprehensive literature is available which describes what to collect and how to collect it. These methodological studies have developed over time, as the science of accident investigation and analysis has matured. Further, there are specialist accident analysis techniques that can be used to differentiate between the many possible confounding factors and identify the ones which are most significant (multi-factorial analysis).

Implementation

The costs and timescales of such programmes would need to be understood and to be well defined to ensure a successful implementation. These costs are probably the major barrier. Also, evaluation would be essential to measure whether the programme was effective, was the highway engineering or environmental change effective? This all adds to the cost.

Further, motorcyclists are a specialist group and care is required to ensure that there aren't adverse or unintended consequences associated with any improvement scheme. For example, making the road safer for motorcyclists may make the situation more dangerous for cyclists or pedestrians and care needs to be taken to balance the needs of all road users.

Expected Impact(s), Acceptance

In general terms, the European Commission considered Black Spot Management an efficient tool, good enough to be one of the tools made mandatory by the "Infrastructure Directive" (Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on road infrastructure safety management) and also good enough to fund several studies developing harmonised methods of implementation.

http://ec.europa.eu/transport/road_safety/pdf/projects/ripcord-iserest.pdf

Definitions of Black Spots strongly vary throughout the EU. General figures on which share of PTW accidents occur on PTW black spots (which will likely be different from passenger car black spots) could not be found.

Once a national accident database and a definition for "black spot" are available, identification of black spots is a rather easy and cheap exercise. Costs of black spot management should not be messed up with costs of safety measures which were found necessary by black spot management.

Sustainability

Black spot management as a method is sustainable as long as it is applied. The effects will drop to zero by nature - as soon as all black spots have been eliminated. Countries like Sweden already have arrived at this point.

Transferability

Black spot management requires an accident database, a definition of "black spot" and relatively simple software tool to link these.

Costs and benefits

Several studies have found road safety measures, which have been applied to improve black spots are highly cost-effective (Winkelbauer, 2006; Elvik et al, 2009, p206ff). It is difficult to provide efficiency figures on black spot management as a methodology. Costs of black spot management have to added up with the costs for implementation of the measures that have been taken to improve black spots.

Please also see the example from Australia above.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it offers the potential to significantly reduce the number of fatal accidents in black spots.

Priorities

Black Spot management is top-ranked by experts, receives top appreciation by riders and is proven to facilitate highly cost-effective road safety improvements.

6.2. Measures supporting the Self-Explaining Nature of Roads

Signposting of Speed Limits at Dangerous Spots in Curves

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★☆☆
Efficiency	★★★★☆	Sustainability	☆☆☆☆☆

Bad forward sight in curves is considered to be a major cause for motorcycle collisions. Appropriate signposting is a countermeasure for such collisions. The dimension and quantity of signs shall be related to the location of the specific bend.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. The alignment of three different types of signposts is described in detail: onesided posting, twosided posting and choice of oversize signs. This measure aims at decreasing the number of accidents in curves.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.19

FSV states that signposts should just be situated if they are really necessary (e.g. in curves with bad forward sight). Particularly, clustering of signposts should be avoided. In general, as PTW riders especially focus on the lane, road markings are of more importance signposts.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.8

Different programs or guides to address collisions involving motorcycles on bends have been carried out. The Victoria MBP (Motorcycle Blackspot Program) focusing for example on loss-of-control sites

*http://www.msf-usa.org/imsc/proceedings/b-Andrea-*StrategicMotorcycleSafetyPrograminVictoriaAustralia.pdf

A guide for addressing collisions created by the US Transport Research Boards NCHRP

http://144.171.11.107/Main/Public/Blurbs/160626.aspx

A French study carried out to detect the prototypical accident scenarios in urban areas as for instance “obstructed visibility”

www.etcproceedings.org/

A Spanish project elaborated with the aim of monitoring accidents and defining “blackspots” and the respective countermeasures.

Beneficiaries:

The measure is beneficial for PTW riders as it increases the riders’ awareness in curves. By placing the signposts in position and by using signposts of the right size, the number of accidents in curves can be decreased.

Figure 6: Speed limits in Curves. Source: KFV

Clear definition of the problem

The obvious problem is the large number of PTW accidents in corners. The underlying problem is riders going too fast around corners. Assuming riders do not intentionally fall off their vehicles in corners, the underlying problem can be found in the estimate of riders about possible speed. Road design can either promote or impair correct estimates by riders and other road users. If road design at a certain spot is found to impair correct estimate of possible speed, this problem may be tackled by placing speed sign ahead of the corner as a measure second to improving visibility and recognisability of a corner or reconstructing the road.

Size of the problem

The overall problem in terms of PTW safety largely varies between countries, however, run-of-the-road accidents in curves are the most frequent type of accident among single vehicle accidents.

Scientific Background

Higher speed reduces a rider’s ability to control the PTW, negotiate curves obstacles in the roadway and increase the chance of running off the road or into an on-coming vehicle. Among others the failure to follow speed limit contribute to crash and injury risk (NHTSA, 2001).

Implementation

This measure can be implemented cheaply and easily.

Expected Impact(s)

It will support the riders in choosing appropriate speed and hence decrease the number of accidents in corners.

Acceptance

Assuming such signs only communicate existing speed limits or reasonable speed limits, riders, if they do not like such signs, can simply ignore them and hence, will hardly interfere with implementation of the measure. New speed limit might create resistance by riders.

Implementation could be objected by road authorities having to bear the costs of placing signposts.

Sustainability

A speed sign, which is place outside a typical collision path in a corner has a lifetime of about ten years, before the reflective film fades. But that is not the typical problem of sustainability. The naturalistic driving experiments in 2BESAFE as well as many other studies before have found that PTW riders do not always move within the speed limits. Hence, speed signs might not be the best way to make them slow down - except these signs have a true and reliable message. Huge safety margins between the speed required by a sign and the technical maximum will hardly encourage riders to obey these limits. Notably, all these conclusions apply to corners, where forward visibility is bad and road users are likely to misjudge possible speed.

Experts provided a very low rating for sustainability. It may be assumed that this, on the one hand, refers to the conclusions drawn in the previous paragraph. On the other hand, speed signs treat the symptom instead of the cause. They are second to improving visibility or reconstruction of a "bad" road section.

Transferability

Signs can be used everywhere.

Costs and benefits

Placing informative signs is generally considered a low cost measure.

Riders’ perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Warning before a certain risk always has be considered second to eliminating the risk, which may be an explanation for the poor rating on sustainability.

Installation of Rumble Strips

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★★★☆
Total impact	★★★★☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★☆☆☆☆

Rumble strips are small raised features across the carriageway with a vibratory, audible and visual effect. They are usually used in rural areas, to alert drivers to take greater care in advance of a hazard such as a bend or junction. They comprise of a number of narrow strips of material that are laid transversely across the carriageway. Rumble strips are normally laid in a series of groups consisting of between two and five strips per group. The spacing between these groups can vary.

They are especially effective on straight stretches followed by a sharp curve. But hereby, a sufficient safe distance to brake in front of the curve must exist. To ensure that no road user can drive round the rumble strips, they should span the whole roadway width.

Rumble strips are also used in combination with a gateway to indicate the entry to a village or the start of traffic calming measures. In urban areas they have also been used to designate the start of shared space in new developments.

Example:

This measure is recommended in “Motorrad fahren – auf sicherer Straße!“ published by ADAC and DVR. In this brochure, it is said that pilot projects have been carried out successfully in Nordrhein-Westfalen as well as in the region of Pfälzer Wald.

ADAC, DVR (2010) Motorrad fahren – auf sicherer Straße!, p.18

Speed reduction devices (traffic calming devices) needs to be taken into consideration (from PTW point of view) when designing an infrastructure, with an objective to guarantee the safety of all users. There are some guidelines-recommendations providing guidance to engineers and road safety professionals on PTW issues concerning these devices: Avoidance of loss of grip; Avoidance of big change in vertical alignment while maintaining their surface grip. Therefore these inhibitors will be safe for the motorcyclist; the use of different colours is another way of indicating speed limits; correct location of these devices on difficult road sections (instead of speed reduction devices) as a curve or a series of curves (variable vertical signs recommending him to adapt his speed accordingly and the use of some speed inhibitors can be hazardous to the motorcyclist if the bumps appear rather unexpectedly and give the road rugged surface).

Figure 7: Example of some speed inhibitors which can be hazardous

Guidelines from the Motorcycle Industry in Europe: ACEM, the Motorcycle Industry in Europe. “Guidelines for PTW-Safer road design In Europe”:

http://www.acem.eu/media/d_ACEMinfrastructurehandbookv2_74670.pdf

Guidelines from United Kingdom: IHE (Institute for Highway Engineers):

http://www.motorcycleguidelines.org.uk/furniture/documents/guidelines/live/MG%20Chapter%208%20Traffic%20Calming%20v1.0.pdf

Beneficiaries:

The measure is beneficial for all road users but especially for PTW riders as it increases the riders' awareness in curves. By installing rumble strips, the number of collisions in curves due to speeding can be reduced.

Figure 8: Rumble strips[9]

Clear definition of the problem

Some sites, predominantly in rural areas have a history of 'loss of control' accidents at bends the road, or there is a history of accidents at hazardous junctions.

Size of the problem

In 2010, there were 109,150 recorded injury accidents on non-build up roads (Source: Road Casualties in Great Britain, 2010). The number of accidents where a vehicle was travelling around a bend on rural roads, and include contributory factors, e.g. travelling too fast for conditions, exceeding speed limit or loss of control can be extracted from the STATS19 database.

Scientific Background

There have been research studies conducted by TRL which have assessed the implementation and the effectiveness of rumble strips.

- TRL Project Report 33 (Webster and Layfield, 1993) - 'An Assessment of Rumble Strips and Rumble Areas' gives the results of an assessment of the effectiveness of the use of rumble strips across a number of sites in the UK and also gives details on the materials used and how the spacing between strips was calculated.
- TRL Lab Report 800 (Sumner and Shipley, 1977) – 'The use of rumble strips to alert drivers' investigated the effectiveness of rumble strips at 10 sites throughout the UK.
- TRL report 203 (Barker, 1997) – 'Trials of road safety engineering measures' summaries the results of trials using a number of different types of engineering measures, including rumble strips, on rural roads.

Expected impact

The strips when used in rural areas tend to be road safety related and therefore could be expected to have an impact on casualties.

[9] Source: ADAC, DVR (2010) Motorrad fahren – auf sicherer Straße!, p.18

When used in housing estates they act as a speed reduction element and as such, could assist in lowering speeds.

They can cause mobility issues for motorcycles and pedal cyclists if installed kerb to kerb.

They could cause a ground borne vibration issue if sited too close to residences.

Implementation

The trials of road safety engineering measures report (Barker,1997) showed that at the single rural UK site with a history of 'loss of control accidents', over the year following the installation of the scheme, reductions in mean speed of light vehicles at the apex of the bend was 3mph.

Results of the TRL study (Webster and Layfield, 1993) showed that the effect of rumble strips on the 85th percentile speeds was a reduction of 3mph (about 6 percent). There was evidence from some sites that 'after' speeds increased slightly with time, but were still below the 'before' installation speeds. There was a reduction in injury accident frequency of 28%, but due to the very small number of accidents involved, this result was not statistically significant.

The earlier TRL study (Sumner and Shipley, 1977) showed that there was some evidence on speed reductions on the approach to hazards after the installation of rumble areas and at some sites there was evidence in the reduction of incidents which may have lead to accidents. However, these speed and driver behaviours were not consistent at all sites. There was a reduction in injury accident frequency of 35%, but again due to the very small number of accidents involved, this result was not statistically significant.

Acceptance

Concerns might be raised by road authorities bearing the expenses of implementation. Passing over the rumble strips could increase noise and hence, receive resistance from residential who do not appreciate the safety impact.

Sustainability

Evidence has shown that speed reduction will be eroded with the passage of time. At some sites drivers have learned how to accelerate over the devices to lessen the vibratory effect.

Transferability

Rumble strips can be used at a variety of locations but must meet traffic calming guidelines.

Costs and benefits

No up- to- date cost estimates to install thermoplastic rumble strip schemes are available, but from the schemes studied it would appear that the typical range of installing thermoplastic rumble strips would be between £500 and £1500 at 1993 prices.

Riders' perspective

★☆☆☆☆

(no comment)

Priorities

Similar devices exist in other countries including the Netherlands; they are used as one measure amongst others to reduce casualties and are not always appropriate in all locations.

Clarification / Highlighting of Longitudinal Roadway Arrangement

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★☆☆☆	Transferability	★★☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆

Efficiency	★☆☆☆☆	Sustainability	★☆☆☆☆

The visibility of the longitudinal roadway alignment shall be improved through destination panels, marker posts and road markings. Thereby, road signs shall inform riders about dangerous roadway alignment, whereas texts and additional signs as additive information devices are not recommended as they distract riders from their main task. On the other hand, the properties of the respective longitudinal marks have to be under the specifications detailed in the existing standards at European Level.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. This measure aims at decreasing the number of accidents in longitudinal traffic within curves. Possible causes for such accidents were identified as follows: risky overtaking, motorcyclist extended into the opposing traffic and discontinuity of longitudinal roadway alignment.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.18-19

Besides, FSV states that road markings are especially important at accident blackspots as they clarify the longitudinal roadway arrangement. In particular, lane separators, middle lines as well as edge lines are beneficial for improving PTW safety.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.6

The existing standards on Road Marking at European level are as follows:

+ Products:

- EN 1423: Drop on materials (Glass Beads & Anti-Skid particles).
- EN 1790: Preformed Road Markings.
- EN 1871: Liquid (components for) Road Markings.

+ Durability tests:

- EN 13197: Indoor Wear Simulator test.
- EN 1824: Road test.

+ Performance Parameters:

- EN 1436: Performance requirements: It describes performance requirement for road markings in use as:
  - Daytime visibility.
  - Night-time visibility:
    - Dry condition (“before the rain”).
    - Wet condition (“after the rain”).
    - Rain condition (“during the rain”).
  - Skid resistance (wet – friction coefficient).
  - Colour (only white and yellow in standard).

http://www.cen.eu/cen/pages/default.aspx

Beneficiaries:

The measure is beneficial for PTW riders as it allows better visibility of longitudinal roadway alignment. It is closely related to the improvement of forward visibility in curves. It is more or less the default solution if unexpected alignment cannot be made perceivable by other means, e.g. by removing sight barriers. Unfortunately, there is also a big disadvantage linked to this measure: Every signpost dedicated to improve recognisability of a curve also represents a possible obstacle to crash against.

Figure 9: Highlighting of Longitudinal Roadway Arrangement. Source: KFV

Clear definition of the problem

The handling of a motorcycle in a curve is governed by the principle called "where you look is where you go" by trainers: focusing on the vanishing point of the curve helps steering in that direction. Therefore, roadside elements and geometry that lead to a fixation on another point, can cause a change in trajectory and increase the likelihood of an accident.

Size of the problem

Potentially all bends on secondary roads. According to the results of the MAIDS study (ACEM, 2005), 25% of PTW accidents leading to injuries occur on country roads; and in 21% of cases in a curve.

Scientific Background

In 2002, Buckinghamshire County Council improved signage at an intersection following 3 deaths, 5 serious injuries and 2 slight injuries to bikers during an eight-year period. The improvement involved the installation of bollards highlighting the curve geometry between the vanishing points at both ends. Between 2002 and 2005, there have been no further biker collisions on this bend.

In Germany, a working group "Motorcycle Accidents" was established in 2003 by the German Road and Transportation Research Association (FGSV e.v.) to develop guidelines to increase motorcycle safety with an improved infrastructure. The final product, the MVMot guidelines manual, is based on an analysis of accident statistics on the roads studied, an identification of black spots, followed by an analysis of the causes of accidents, the local situation, and an evaluation of possible improvement measures based on a collection of best practices. The implemented concept is then evaluated for effectiveness.

Expected impact

The measure is expected to lead to a reduction in accident frequency and, if combined with other measures to improve road infrastructure for PTW riders, a reduction in injury severity and casualties. In Norway, roadway arrangement clarification was implemented in 2008 on Highway 32, one of the country's ten most accident prone roads, along with other measures for motorcycle safety. Since then, no motorcyclist casualties have been reported along that road. In Germany, all regional governments now implement the guidelines of the MVMot manual.

Implementation

Barriers to the implementation of the measure include cost and lack of awareness. Both can be overcome if the measure is integrated into existing road safety audits, guides of best practice, road engineer training and the traffic code. It should be implemented in priority on motorcycle black spots, on motorcycle roads (as defined in the MVMot manual), and as part of a wider strategy aimed at improving all aspects of the infrastructure to increase PTW safety.

Acceptance

Concerns might be raised by road authorities bearing the expenses of implementation.

Sustainability

The measure is highly sustainable, providing the signage is not removed or changed by later improvement or maintenance works. No behavioural adaptation or risk compensation is to be expected.

Transferability

The measure is highly transferable to all country roads that display the characteristics listed above: impaired visibility, unpredictable curvature or dangerous roadway alignment, especially on accident black spots and roads often used by motorcyclists.

Costs and benefits

Cost in infrastructure works is minimal. Costs can be reduced if the measure is fully integrated into existing guides of good practices, in the curricula of traffic engineering degrees, in road safety audits, and in guidelines for the identification of black spots.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Although there is some evidence for this measure to be successful and relatively cheap, the expert judgment resulted in rather low ratings. This might be due to the fact that PTW safety experts are in favour of building self-explaining roads instead of trying to make them self-explaining once they exist. Furthermore, experts could strongly consider additional signs as potential obstacles, since they have to be placed in the danger zone of riders falling and leaving the roadway.

Enhanced lane separation by floor markings

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★★☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★★☆☆
Efficiency	★★★☆☆	Sustainability	★★★☆☆

Lane cutting is a typical PTW-related risk, where drivers as well as riders can be both offender and victim. Floor markings can be used to increase distance between drivers and riders in corners, where cutting is common and causes head-on collisions. Even though – according to legal provisions – floor marking should have similar skid resistance as the surrounding road surface, PTW riders tend to avoid crossing these markings.

Example:

This measure was tested on typical high-risk motorcycle routes successfully. Different layout variants were tested, the one shown in the picture below was found most effective.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, " Bildanhang", p.7

Beneficiaries:

Head-on collisions induce - besides single vehicle crashes - the most severe consequences even for car users if colliding with PTW. However, PTW riders might sustain more severe injuries in such a scenario.

Figure 10: Floor markings for enhanced lane separation in curves[10]

Clear definition of the problem

Accidental run-off in curves is a real risk for motorcyclists and, to a lesser extent, for car and other vehicle drivers. Due to an inappropriate trajectory during cornering, unpredictable road alignment, sudden changes in the curve radius, skidding due to a slippery road surface, or an emergency maneuver, the motorcyclist can come close to the separation line or cross it entirely, exposing him or her to the risk of a frontal collision with an oncoming vehicle. Likewise, other vehicles can also partly cross into the opposite lane, exposing the motorcyclist to the risk of frontal collision.

Size of the problem

According to the results of the MAIDS study (ACEM, 2005), 25% of PTW accidents leading to injuries occur on country roads; and in 21% of cases in a curve.

Scientific Background

The MVMot manual (see above) suggests the use of double separation lines in curves on motorcycle roads (country roads with little heavy vehicle traffic and high motorcycle traffic), with a distance of 50cm between the lines.

Expected impact

When negotiating a curve, motorcyclists tend to maximize the use of the lane they are travelling on. During the three phases of cornering, a PTW will first move to the outermost part of the lane, then to the innermost part as he or she reaches the apex of the curve, then again towards the outer section of the lane as he or she exist the curve. Furthermore, due to the tilting of the motorcycle and the motorcyclist during the maneuver, their combined width increases temporarily. Therefore, enhanced lane separation can reduce the risk of frontal collisions in curves, by eliminating the risk of collision entirely or by giving drivers and riders more time to recover after a loss of control. Since frontal collisions are the worst type of configuration for all road users, the impact of the measure is expected to be high.

Implementation

Barriers to the implementation of the measure include cost and lack of awareness. Both can be overcome if the measure is integrated into existing road safety audits, guides of best practice, road engineer training and the traffic code. It should be implemented in priority on motorcycle black spots, on motorcycle roads (as defined in the MVMot manual), and as part of a wider strategy aimed at improving all aspects of the infrastructure to increase PTW safety.

In Germany, all regional governments now implement the guidelines of the MVMot manual.

[10] Source: FSV working group PTW safety, Bildbeilage

Acceptance

Concerns might be raised by road authorities bearing the expenses of implementation. A non-representative survey among riders found good acceptance by riders.

Sustainability

The measure is highly sustainable, providing the lane markings are not removed or changed by later improvement or maintenance works.

Transferability

The measure is highly transferable to all country roads, especially on accident black spots and roads often used by motorcyclists, as well as on roads that display any of the following characteristics: impaired visibility, unpredictable curvature or dangerous roadway alignment.

Costs and benefits

Cost in infrastructure works is minimal. Costs can be reduced if the measure is fully integrated into existing guides of good practices, in the curricula of traffic engineering degrees, in road safety audits, and in guidelines for the identification of black spots.

Riders' perspective

★★★★☆

The riders' associations support this measure because it mitigates the consequences of a loss of control or a riding error, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

This measure was experienced to be effective; however, experts tend to be in favour of sound scientific evaluations before providing excellent ratings. Hence, more research on this measure is required before a best-practice status can be achieved.

Elimination of Sight Barriers in Curves and Improving Sight

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★☆
Total impact	★★★★★	Implementation	★☆☆☆☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★★★☆☆

Bad forward sight in curves is considered to be a major cause for motorcycle accidents. Riders of single track vehicles strongly depend on good forward visibility in curves for two reasons:

- Navigation in a curve has to be oriented much further ahead for PTWs than for any other vehicle in order to be able to achieve a homogenous trajectory.
- Decelerating a single-track vehicle in the corner is much more than just pressing the brake and letting the ABS do its job. There is – compared to passenger cars – a huge risk in abrupt braking manoeuvres originating from blocking either the front or the rear wheels or both. Even if a single-track vehicle is equipped with an ABS that eliminates the risk of falling by blocking one of the wheels, reduced speed requires reducing the roll angle accordingly, which is not an easy exercise in case of emergency braking. Increased forward visibility decreases the risk of emergency break. Hence, good forward visibility in corners reduces the risk of single-track vehicles.

There are several means of improving sight in curves. Elimination of sight barriers as well as improved alignment are countermeasures that tackle this issue.

Improving sight lines can be applied at various situations, including bends and junctions. Improving sight lines gives road users improved view, either of the road ahead or of approaching traffic when attempting to emerge from junctions Additional delineation of the roadside can be applied to aid bend assessment. Consideration for riders during specification and positioning of in-road and roadside furniture, including impact characteristics when struck by a fallen or sliding body.

Example:

The measure originates from the national motorcycle guideline "Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken" published by FGSV. Because in the in-depth accident investigation, it was found out that poor visibility due to sight barriers is one of the major causes for PTW accidents in curves. Thus, this measure aims at decreasing the number of accidents in curves.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.16

Beneficiaries:

The measure is beneficial for all kinds of single-track vehicles since the particular problem of balance is equal for bicycles, mopeds and motorcycles. Nevertheless, motorcycle riders are the primary target group since they normally cruise at the highest speed among this group. Any other road user will also benefit from improved visibility in curves, however possibly not to the same extent as PTW riders.

Figure 11: Removal of sight barriers in curves[11]

Clear definition of the problem

Some sites, predominantly in rural areas, have a history of 'loss of control' accidents at bends in the road.

Many crashes occur at junctions, particularly in urban situations, where the drivers of emerging vehicles fail to see the oncoming motorcycle.

Good forward sight assists all road users in correct judgement of the situation and correct choice of speed. Vice versa, bad forward sight brings about additional risk of misjudging a corner, an intersection or any other traffic situation and, hence, creates additional risk of inappropriate speed choice.

Size of the problem

In 2010, there were 109,150 recorded injury accidents on non-built up roads (Source: Road Casualties in Great Britain, 2010). The number of accidents where a vehicle was travelling around a bend on rural roads, and include contributory factors, e.g. travelling too fast for conditions, exceeding speed limit or loss of control can be extracted from the STATS19 database.

A high proportion of crashes between motorcycles and cars in urban situations are due to emerging drivers failing to see the oncoming motorcycle. In rural situations motorcycle approach speeds are likely to be higher.

Anecdotal evidence suggests that riders who are losing control of their machine on a bend tend to "fixate" on the object in their path most likely to hurt them - typically a tree or signpost.

[11] Source: FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.26

Research (unpublished DfT STATS19 data, also ATSB 2000 quoted in MCC 2002) indicates that a significant percentage of motorcycle fatalities (17% in GB in 2003) where there is a collision with object at the roadside.

Scientific Background

UK Design Manual for Roads and Bridges covers both the assessment and preparation of road schemes and road safety audits, detailing aspects for all road users. However, many of these may be critical for riders, such as visibility and sight lines, permanent obstructions (e.g. bridge abutments) and temporary obstructions (such as parked maintenance vehicles). An extensive list of potential obstructions is provided.

UK Institute of Highway Engineers Guidelines for Motorcycling, Improving Safety Through Engineering and Integration, gives considerable guidance on incorporating motorcycles into road design and traffic engineering and subsequent audits, including roadside furniture, riders' eye level and obstruction of view.

ACEM (the Motorcycle Industry in Europe) Guidelines for PTW Safer Road Design in Europe incorporates guidance on riders' eye level, obstruction of view and concealment of the motorcycle.

Road Safety Management of the Highway Network, presented by Chris Baguley (Transport Research Laboratory) at the International Symposium on Traffic Safety Strengthening and Accident Prevention, Nanjing, China. Nov 28-30. 2001, explained aspects of design and draft plans incorporating alignment and sightlines and potential obstructions, and the determination of sight lines during site visits.

Expected impact

Improvement of sight lines through bends could improve rider assessment of bends, particular if used in conjunction with hazard markers.

Improvement of sight lines at junctions could improve rider safety by allowing drivers an earlier opportunity to identify approaching motorcycles.

Implementation

Buckinghamshire County Council implemented a specific bend treatment involving cutting back roadside vegetation and placing hazard marker posts on the outer edge of the bend, aiding riders to determine the 'vanishing point'. This treatment, known as 'WYLIWYG' (Where You Look Is Where You Go) was implemented on a bend where there had been three rider fatalities and a significant number of serious injuries during the preceding eight years. In the three years after the treatment was applied, there were no rider collisions recorded.

Acceptance

Concerns might be raised by road authorities bearing the expenses of implementation.

Sustainability

Improvements in visibility may encourage riders to approach a treated site at speeds and, thus, compensate reduce objective risk.

Transferability

Improvement of sight lines can be applied in a range of situations, such as bends and junctions, in both rural and urban environments. It may be assumed that the impacts are similar, wherever such treatment is implemented. This applies to both the intended as well as potential negative impacts.

Costs and benefits

Costs of interventions would depend on the scale of the work undertaken. Incorporation during the planning stage of new roads or improvement schemes would offer the most cost-efficient benefit.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Improvements to sightlines are recognised as beneficial by many road road safety programs, e.g. the ACEM (the Motorcycle Industry in Europe) Guidelines for PTW Safer Road Design in Europe. They might be as beneficial for other road users.

Predictable Curvature

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★★☆☆
Total impact	★★★★★	Implementation	☆☆☆☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★☆☆☆	Sustainability	★★☆☆☆

Curvy roads are often popular among motorcyclists. This is most likely due to the fact that curves give the motorcyclist greater driving technique challenges and greater experiences from the effects of physical forces. Moreover, many curvy roads offer exceptional natural scenery and some of these roads have little traffic. But because driving motorcycle on curvy roads represents an additional challenge, it may also be more risky. Next to problems like poor road grip, obstacles and hazardous road installations on outer curve, unpredictable curvatures are a high risk for PTW riders: Because of difficulties with braking on turns, the motorcyclist has an even greater need of predictability than does the motorist. This concerns predictability regarding curvature and road grip on approaching curve and relative to the direction of the road ahead.

Example:

This measure derives from "MC Safety", which is a handbook published by the Norwegian Public Roads Administration. In this handbook, it is said that if the curve radius gradually gets smaller or the road unexpectedly changes direction, an inexperienced driver might get into problems. He can be misled to choose too high a speed when entering a turn that will be more demanding than it appears. This type of problem can easily result in the motorcyclist coming over onto the opposing lane in a right turn, or driving off the road on a left turn.

Norwegian Public Roads Administration (2004). MC Safety, pp.12-13

Beneficiaries:

A predictable curvature will normally not represent any major problem or particular risk to motorcyclists. Hence, building roads with a predictable geometry is beneficial for all road users, especially for PTW riders, as this measure reduces the total number of accidents.

Figure 12: Predictable Curvature. Source: KFV

Clear definition of the problem

Disharmonic curvature, especially small radii after a road section with a big one are critical for PTW-riders. A missing straight road stretch between both radii maximizes the risk, because breaking manoeuvres have to be done in sloping positions. Additional risks exist in that situation, if the visibility to oncoming curve is poor.

Size of the problem

Especially for inexperienced riders and on unknown routes the risk factor arising from the curvature is remarkable. In combination with speeding that risk factor is a contributing to crashes in about 6 to 10% (estimation).

Scientific Background

Almost all road design guidelines handle that problem in so-called “radii tulips”. Relations of following radii with fixed values, depending on the design speed, are foreseen. Those theoretical values are based on experiences and vehicle dynamic aspects of passenger cars. Curvature change rates based on scientific work for other road users (like PTWs) are under development in several projects.

Moreover, visibility issues related to the curvature is basis of many research projects. National guidelines regulate the plantings on the road side.

Expected impact

It is expected that this measure will have an impact on road safety as the curvature is contributing to crashes in about 6 to 10% (estimation). But it might also be possible that side effects like risk compensation are likely. Amongst others, potential risks concerning curvature have been identified in 2-BE-SAFE WP 1, Activity 1.2 (Influence of road infrastructure on PTW crashes). Especially the microscopic analyses of Austrian data focused on the radii relations. It was found out that small radii in general are more critical than bigger ones.

It could be determined if this measure was working well by re-planning a critical spot in the course of before-after analyses.

Implementation

With respect to the implementation of this measure, there are several barriers like costs for reshaping a trace, lack of money, missing knowledge and non-existent road safety audits or road safety inspections. Another critical issue which should be considered in implementing this measure is that it is sometimes not cost-effective, particularly for PTW safety (risk compensation theory).

Awareness of this measure can be raised by in-depth accident analyses, simulation of vehicle and crash dynamics (reconstruction) as well as by updating the road design directives.

Acceptance

The acceptance of PTW riders can be raised by awareness campaigns, simulator studies as well as in-depth black spot analyses. If the public does not consider the measure to be effective, awareness campaigns could be launched, directives and norms on road design could be updated and road planners could be trained.

Sustainability

This measure is believed to be sustainable because road geometry usually stays constantly. Maybe after decades and land movements some factors (e.g. crossfall) might change slightly.

Transferability

This measure is applicable throughout the world. It is useful on all roads in several areas and it is also important for other road users beside PTW riders.

Costs and benefits

It is simple to quantify the costs, but the monetary estimation of the safety effects is more critical. Hence, no exact numbers are known.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

This measure is beneficial to all road users, but mainly applies to new roads, where is should receive top priority. The overall rating is lower, since rebuilding road can hardly be justified only for the sake of achieving predicable curvature.

Transitional vs. circular bends

Expert Assessment			
Overall		★☆☆☆☆	
Size	★☆☆☆☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	★★★☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

A bend usually comprises two types of curve: a transition curve at entry, followed by a circular curve, then another transition at exit. Entirely transitional curves, without any circular element, are also common. Transition curves are recommended for road design to reduce the abruptness of change from a straight line to a curve. However, the main impetus for the use of transition curves on roads came from railway engineering to produce a gradual change in curvature and therefore in centrifugal acceleration. This technology was transferred from rail to road. But investigations of various bends show that the main criterion concerning their safety is directly linked to these transitions: Drivers have more difficulty in perceiving the curvature of a transitional bend than of a circular bend, because a transitional bend can deceive them into maintaining an excessive speed.

Example:

In Scotland, three accident-prone bends were converted from transitional to circular alignment. Comparing equal before-and-after periods, accidents have been reduced significantly by about 80%, and cost-effectiveness has also been high.

Stewart D., Cudworth C. (1990) A remedy for accidents at bends, p.88

Beneficiaries:

The results of the realignment of the bends suggest that accidents, especially PTW accidents with other vehicles, at sub-standard bends could be prevented.

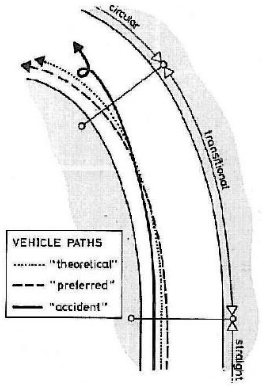

Figure 13: Vehicle paths on transition curve[12]

Clear definition of the problem

An unpredictable or suddenly changing radius in a curve forces motorcyclists to correct their trajectory mid-curve to adapt to the decreasing radius. Due to the physics of PTWs, the adjustment is difficult to make mid-maneuver, and can lead to a run-off, a fall, or an impact with roadside furniture or oncoming vehicles.

Size of the problem

According to the results of the MAIDS study (ACEM, 2005), 25% of PTW accidents leading to injuries occur on country roads; and in 21% of cases in a curve. No data is available on the frequency of transitional designs in road infrastructure.

Scientific Background

The principle of predictable road geometry for PTW safety is recognized by the rider community, and has been integrated into the design guidelines for road infrastructure of several countries (example*: Handbook 425: Motorcycle Safety, a motorcycle guide for highway engineers*, Norway).

Expected impact

Unpredictable road geometry, due to poor visibility or non-continuous radius (transitional curves) is a major accident factor in accidents occurring in curves on country roads. The measure would play an important role in improving accident black spots on existing roads, and in making sure that new infrastructure is designed with the safety of motorcyclists in mind.

Implementation

Barriers to the implementation of the measure include cost and lack of awareness. Both can be overcome if the measure is integrated into existing road safety audits, guides of best practice, road engineer training and the traffic code. It should be implemented in priority on motorcycle black spots, on motorcycle roads (as defined in the MVMot manual), and as part of a wider strategy aimed at improving all aspects of the infrastructure to increase PTW safety.

Acceptance

Road users will hardly experience the difference, although, as the example shows, there might be some impact to their safety. Acceptance to this measure is a question of s small number of experts in road design and construction.

Sustainability

The measure is highly sustainable, providing that infrastructure design guidelines specifically advise against the use of transitional bends and insist on continuous radius bends.

Transferability

The measure is highly transferable to all country roads, especially on accident black spots and roads often used by motorcyclists, as well as on roads with unpredictable road geometry.

Costs and benefits

The cost of implementing the measure in new road designs or as part of improvement works is minimal. The cost of reconstructing roads displaying transitional bends can be important. If reconstruction is not feasible or pending reconstruction, the option of specific signage warning motorcyclists about the curve ahead or measures improving visibility ahead of the curve are available.

[12] Source: Stewart D., Cudworth C (1990) A remedy for accidents at bends, p. 88

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Building bends using a transitional layout is a very common principle, widely applied globally. It is well supported from vehicle dynamics and questions of available surface friction. Although there might be some advantages in particular to PTW riders, experts might consider a study based on rebuilding three bends not sufficient to provide good ratings, also considering the costs of reconstructing roads. Potential negative impacts to other road users than PTW riders could have also been considered for the rather low rating.

6.3. Measures supporting the Forgiving Nature of Roads

Elimination of Dangerous Obstacles in Bends

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★☆☆☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★★★★

In case of an accident, obstacles such as trees or walls can cause major injuries. These obstacles need to be eliminated or reconstructed. Trees, walls, slopes, etc. have to be removed from the possible falling area or they have to be reconstructed in regard to safety standards.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. It is suggested that trees, milestones, containers for road grit, road gullies, handrails as well as signposts, which are located too close to the road or in the possible falling area, should be removed. Besides, it should be considered that curbs, which are too high, can be a severe obstacle, too.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.16

On PTW accident-prone routes, single fixed guide posts, which are place in the possible falling area, should either be relocated in a safe distance or provided with impact absorbers.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.7

Beneficiaries:

The measure is beneficial especially for PTW riders as it enhances passive safety by eliminating obstacles alongside the road.

Figure 14: Dangerous obstacles in bends[13]

Clear definition of the problem

Hitting an obstacle after the crash is causing the highest risk for fatal PTW accidents. Due to the fact that PTW users are more or less unprotected, collisions with fixed objects are highly dangerous. Especially in bends (risk of run-off road accidents), an elimination of safety critical obstacles must be given a high priority.

Size of the problem

Depending on the road type and area this specific risk is a factor in 2 to 50% of fatal crashes. Obstacles in bends are not a crash causes itself, but the severity rate is proportional to the fact, if an obstacle was hit or not.

Scientific Background

Scientific evidence, which supports the implementation of this measure, are amongst others the MAIDS study, several crash test data and crash reconstructions, the EU project RISER as well as the ERA-NET project IRDES.

At first, the problem has to be identified. If the obstacle is not useful for other road users the removal/ elimination can be done. On motorcycle routes, a crash barrier, which has not been “used” for several years (rusty steel), might also represent a dangerous obstacle, which should be removed, too.

Expected impact

An impact can be expected in the areas road safety as well as environment (less smashed gasoline and oil tanks). It looks as though side effects were not likely. Although accident analyses related to crashes in bends were carried out in the course of 2BESAFE (especially within WP1, Activity 1.2, studies from the UK and Spain show some specific results) the impact cannot be exactly quantified in advance. Because of this, crash analyses before and after removing the obstacle should be conducted.

Implementation

Barriers concerning the implementation of this measure are the obstacles themselves as they are given by historical grown landmarks or trees. Additionally, road authorities might block this measure as they are often unaware about the critical aspects for PTW riders. Besides, PTW riders must know the fact that some obstacles can never be removed (e.g. rock walls, other constructions near the road, forests, etc.). After having implemented this measure, the awareness can be raised by publishing guidelines for PTW safety including this measure and by implementing of “forgiving roadsides”.

Acceptance

If this measure is not accepted because those concerned do not consider the problem to be a problem, the awareness can be raised by demonstrating the potential danger of such obstacles in bends.

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[13] Source: http://www.jmooneyham.com/shadowfast-supercar-over-the-edge.html, 3 Aug. 2009

If the public does not consider the measure to be effective, crash reconstructions as well as the promotion of specific cases in public media (raise awareness) might have an influence on them.

Sustainability

Basically, this measure is hardly linked to any risks concerning fading effects. Perhaps, there might be a fading effect when e.g. a tree is just cut but not completely removed.

Transferability

This measure is transferable throughout the world. The impact is expected to be the same in every country.

Costs and benefits

As the obvious benefits are critical to estimate, whereas the costs side is easy to calculate, there is no exact monetary value available. Nevertheless it is clear that this measure is very cheap and effective.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to the reduction of accident severity, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Considering all these issues and the good expert rating, this measure should receive strong attention, in particular in construction of new roads and reconstruction projects. For existing roads, activities should focus on obstacles, which can be easily removed.

Provision of Full Paved Shoulders

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★★☆☆☆
Total impact	★★★★☆	Implementation	★☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	☆☆☆☆☆	Sustainability	★☆☆☆☆

Shoulders are desirable for all vehicle types, but provide particular benefits to motorcyclists. For example, motorcyclists that run-off the roadway or experience mechanical problems within a confined cross section (e.g., bridge, work zone) with no shoulder are especially vulnerable to traffic following in their path of travel. That is, motorcyclists do not have a vehicle to provide at least limited protection and to make them more visible to oncoming or following traffic. By widening the shoulders, or providing a shoulder where one previously did not exist, motorcyclists have a refuge area out of the travelled way to accommodate motorcycle breakdowns. They also have more recovery area to regain control of their errant motorcycle before encroaching on the roadside, thereby reducing the risk of an impact with a fixed roadside object.

Example:

The state of Iowa has conducted a study to evaluate the costs and benefits associated with paved shoulders on primary highways in the state. This study reviewed current design criteria as well as state crash data and decided upon a minimum 3-ft (corresponds to 1 meter) paved shoulder width on rural highways in the state.

http://www.ctre.iastate.edu/reports/pavedshoulder.pdf

Beneficiaries:

Although full paved shoulders are beneficial for all road users, they particularly increase the safety of PTW riders: On the one hand, they are a refuge area in case of mechanical problems and on the other hand, they offer an enlarged recovery area if the rider loses control of his PTW.

Clear definition of the problem

On the one side riders filter between cars in order to avoid stops, if there is no separate lane they can use. On the other side riders are often overseen by car drivers, an additional space on the road allows certain evasion manoeuvres.

Size of the problem

The Australian Transport Accident Commission (TAC, 2006) mentioned single vehicle accidents of PTW riders, because of runoff road or collisions with stationary vehicles, with a percentage of 43 percent fatalities and 56 percent serious injuries.

Scientific Background

Paved shoulders are justified by improved and smoother traffic operations, enhanced highway safety and reduced maintenance. Studies have cited reduced accident rates with the use of paved shoulders (TRB Special Report 214, "Designing Safer Roads - Practices for Resurfacing, Restoration, and Rehabilitation" and Publication No. FHWA/RD-87/094).

The cognitive conspicuity of PTW riders is poor because of low exposure frequencies, and unexpected locations (driving between lanes), which are inconsistent with the other vehicle drivers' expectations.

Implementation

Additional costs for construction and maintenance and additional sealed surface are barriers to implementation.

It is recommended that the shoulder should be constructed of the same materials as the mainline road in order to facilitate construction and reduce maintenance costs (FHWA, 1990).

Usage of adequate surface materials and subsurface drainage has to be guaranteed.

Expected Impact(s)

- It will provide additional space for accident avoiding manoeuvres. An analysis supporting this statement has been carried out within Activity 2.1 of 2BESAFE by use of accident reconstruction software.
- Focus Group Interviews, done in Activity 5.1 of 2BESAFE showed that riders use restricted lanes in order to enhance their subjective feeling of safety and for comfort reasons. The observation data supports these statements.
- A side effect might be that riders use the paved shoulder as a separate lane and ride more risky.
- A side effect might be that riders and or other road users might increase their riding/driving speed due to the wider road.
- Another side effect: environmental impacts when widening roads.
- This measure is not adequate for all roads. Further research has to be done to analyze on which roads this measure can enhance safety.

Implementation

Building road with hard shoulder is quite costly in terms of construction costs and land use. It might be difficult where space is limited.

Acceptance

Road users will hardly interfere with availability of a hard shoulder; however, road authorities will have to consider significant additional costs in road construction.

Sustainability

It will depend on how a hard shoulder is protected from being used on a regular basis. If it is used e.g. for increasing curve speed by using a more "efficient" trajectory (i.e. cutting curves over the hard shoulder), this might even decrease safety level, since collisions will occur at higher speeds.

Transferability

In principle, this can be done anywhere if additional space is or can be made available.

Costs and benefits

Building a hard shoulder is quite costly; benefits might be compensated by altered road user behaviour.

Riders' perspective

★★★★☆

The riders' associations support this measure because it mitigates the consequences of a loss of control or a riding error, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Considering rather low ratings and concerns with respect to costs and benefits and a couple of potential collateral effects, building roads with a hard should for the sake of PTW safety should not be given high priority.

Technical Standards for Road Restraint Systems

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★☆	Implementation	★★☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★★★★

Much has been done throughout the years to promote road safety and to ensure that roadside furniture meets very stringent requirements, but most actions have been concentrated towards passenger vehicles, heavy goods vehicles and pedestrian protection. In particular the riders require road restraint systems to be more PTW-friendly. Riders are particularly at risk hitting supporting posts of guardrails. Several different systems are available on the market, all promising to avoid such collision. Considering the fact that installation of guardrails is very expensive, testing procedures are urgently needed to proof these systems are as good as they promise to be.

Example:

The Committee of European Normalization (CEN) has mandated the drafting of a new part to the European Standard for road restraint systems (EN 1317-8: “Road restraint systems – Part 8 : Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers”), meaning that in the near future PTW users will be benefitting from roadside barriers studies, designed and tested with their specific safety in mind.

It is also of importance that European Standards already in existence (EN 12767: “Passive safety of support structures for road equipment – Requirements, classification and test methods”) be implemented effectively in all Member States to ensure the maximum safety of the infrastructure for PTW users.

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, pp.8-9

The existing standards (waiting for a harmonization of these standards, at least, at European Level EN-1317-8) concerning the “Motorcyclist Protective Device” criteria were identified in the document “Enquiry concerning the existing standard, regulations and technical specifications in CEN Members countries on the protection of motorcyclists in respect of road restraint systems - CEN/TC 226 Resolution 287 – Oslo - 2007-06-14/15" showing these standards, according to the resolution 287 (Oslo June 2007). Every CEN member was invited to give all the information at his disposal concerning motorcyclist in relation to road restraint systems. The following table was fulfilled for each country:

CEN Member countries	Date of reply	Are there standards, regulations or technical specifications on the subject in your country?				Is there an English version of these documents (1 to 3) ?		
		YES / NO / Not Known	if 'YES'			YES / NO	If 'YES'	If "NO"
			1 List of standards (please give titles, reference and date)	2 List of regulations (please give titles, reference and date)	3 List of technical specifications (please give titles, reference and date)		please give a copy with your answer	please supply a translation by March 30th or at least a summary

Figure 15: CEN questions on national standards for road restraint systems for PTW

Beneficiaries:

By providing road restraint systems especially designed for PTWs, the impact severity of PTW collisions with safety barriers can be reduced. Thus, this measure is particularly beneficial for PTW riders as it enhances secondary safety.

Clear definition of the problem

Most road restraint systems consist of a single steel beam fixed on straight metal poles at a regular interval. While the rail itself is designed to absorb the energy of a crash and restrain an impacting vehicle, it does not offer any protection to a motorcyclist falling off a bike. Motorcyclists sliding under the rail itself will often hit one or more posts, which have no energy absorption properties. As a result, collision with guardrail posts is a major cause of fatal motorcyclist injury, along with serious limb and organ injury often leading to amputation.

Size of the problem

A review of available studies during the Smart Road Restraint Systems[14] (SMARTRRS) European Research project showed that the impact of motorcyclists against a fixed object occurred in 4% of accidents in urban areas, and in between 10% and 20% of accidents in rural areas. Furthermore, a fatal outcome is 2 to 5 times more likely for an impact with a crash barrier than in motorcycle accidents in general.

Guardrails and inappropriate road restraint systems are therefore a major cause of injury for motorcyclists.

Scientific Background

"Etude des accidents de motocyclistes avec choc contre glissières de sécurité" (Brailly, 1998) is a detailed study of 418 motorcyclists accidents against crash barriers.

The accidents of motorcyclists against metal crash barriers in France in 1993,1994,1995 totaled 188 fatalities (63/year), 342 serious injuries and 385 slight injuries. This should be compared with the average figure of 800 motorcyclist fatalities per year at the same period.

The results showed that the risk of fatality per accident against a crash barrier is five times as great as the national rate for all motorcycle accidents and accounts for 8% of all motorcycle fatalities and 13% of fatalities on rural roads.

The conclusions identify curves as specifically dangerous areas, with accidents on the external radius. It recommends the creation of an obstacle-free zone between the road and the barrier. This would allow deceleration before impact with the crash barrier and, as a secondary effect, would benefit other categories of road users as well.

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[14] http://smartrrs.unizar.es/up_files/file/Deliverables/D_1_%203%20Final%20Report%20of%20WP1_version2.pdf

The report also shows that the use of a screen on the lower part of barriers is a way to halve the number of motorcyclist fatalities against metal barriers.

In the countryside, accidents involving motorcyclists colliding with metal crash barriers represent over 30% of the total number of motorcyclists killed in accidents against an obstacle.

Expected impact

Collisions with crash barriers are an important source of injuries for motorcyclists, therefore, the impact in accident severity reduction is expected to be high.

The efficiency of the measure can be assessed by qualitative analysis of motorcyclist casualties in impacts with crash barriers, looking at accident severity (death, serious injury, minor injury).

"Schutzeinrichtungen an Bundesfernstrassen" by Robert Schnuell concludes that protection of all crash barrier sections where accidents have occurred could reduce motorcyclist deaths by 25%, and decrease accident severity by 50%.

In France, the Ministry of Transport in 2001 estimated the cost of equipping all crash barriers with motorcyclist-friendly devices at 600 million Euro. With an average 60 motorcyclists fatalities per year due to crash barriers and a pessimistic hypothesis that these devices would halve the number of motorcyclists' fatalities against crash barriers, this would save 30 lives per year. With an estimated cost for society of 1 million Euro for 1 road fatality, it would take 20 years for a full installation to be cost effective. Cost-effectiveness is therefore much higher if installation of motorcyclists protective barriers are installed primarily in black spot areas where accidents are likely to occur.

Implementation, Costs and benefits

Fitting of motorcyclist protective guardrails achieves the highest cost-efficiency ratio by focusing on black spots.

A typology of black spots has been proposed in Brailly (1998) with general guidelines. Black spots include bends with a risk of skidding (due to poor road surface, gravel, diesel spills, weather conditions or human error), bends with decreasing radius, and locations where a high number of accidents has been reported.

The French Ministry of Transport issued directives to install PTW-friendly guardrails in priority in the following areas: on motorways in curves with an external radius of less than 400 m, on non-motorway roads in curves with an external radius of less than 250 m, and on all roads where banking is present.

Implementation is possible during new road construction, with additional progressive fitting during the course of maintenance activities on existing roads.

Acceptance

Acceptance by the users is high, as the need for motorcyclist protective guardrails has long been acknowledged by the motorcycling community. PTW-friendly guardrails are quite visible, hence, good for communicating a commitment to support PTW safety.

Sustainability

The measure is very sustainable, as long as motorcyclist protective guardrails are properly installed and maintained, and replaced with systems of equal or higher protective value during improvement works or at the end of their service life. Nevertheless, PTW riders might take higher risk if they feel protected by such guardrails and misjudge the remaining risk when crashing into these barriers.

Winter service may be hampered by certain types of PTW-friendly guardrails. In some cases, snow ploughs would have to be replaced by blowers which causes additional cost and takes more time to clear the road from snow. Vice versa, some types of PTW-friendly restraint systems are likely not to withstand forces imposed by winter service. Hence, climate conditions have to be considered when selecting PTW-friendly restraint systems, otherwise effects will fade rapidly.

Transferability

Transferability is high outside of Europe, where other countries can replicate the standardization process with similar requirements, or adopt the CEN standard altogether. Guidelines for installation can also be disseminated outside of the European Union where conditions are sufficiently similar.

Transferability is especially high toward the US, where the Department of Transportation has expressed an interest in the standardization work of CEN for use in the US.

In countries, where snow on the road is an issue, it has to be considered that some of the PTW-friendly solutions strongly hinder removal of snow.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to the reduction of accident severity, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Current priorities include:

- Completion of the standardization work at CEN, in order to deliver an accepted standard that road authorities can mandate for new installations;
- A guide on motorcyclist protective guardrail installation and a list of available products, to be made available to national and local road authorities to raise awareness of the standard and ensure its use;
- In-depth research at European level on the number and characteristics of PTW accidents

This should be completed before extensive use of such PTW-friendly guardrails is initiated.

Wire Rope Barriers

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★★☆☆	Implementation	★☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★☆☆☆☆

The"2+1 road" system was developed in order to avoid head-on collisions on wide rural roads: As the width of these wide roads previous to the intervention encouraged drivers to overtake at high speed, generating head-on collisions, in particular of two vehicles overtaking at a time at the same location. According, e.g. to the Sustainable Safety principle of separating vehicles moving at high speed in diverse direction, an intermediate barrier was required. It was found that the concept is only cost-efficient, if a very cheap intermediate barrier is used, i.e. the steel wire rope barrier.

PTW riders dislike the use of wire rope barriers, they are worried that wire rope barriers would increase severity of injuries or even cause fatal injuries, in case a rider hits either the rope or one of the posts.

Example:

The Finnish Road Administration published the guideline "Quality Requirements for Road Crash Barriers and Selection of a Barrier Type - No 61b", which contains a general basis for selecting road crash barriers as well as instructions on the basis of which a consumer specifies project-specific requirements and general quality requirements for road crash barriers, used in the Road Administration locations.

Beneficiaries:

Cost-efficiency of the 2+1 road concept including the use of steel wire rope barriers was verified by several studies. Hence, according to the principles of macroeconomic cost-benefit assessment, the beneficiary of this measure is society. Unfortunately, cost-benefit assessment, by definition, cannot deal with distributional effects. Even if there is an overall gain, there may be winners and losers. PTW riders consider themselves more at risk by the use of steel wire rope barriers.

Figure 16: Wire rope barrier[15]

Clear definition of the problem

Conventional barrier systems do perform well in protecting the occupants of passenger cars and trucks, however, their effects on the safety of motorcyclists, is problematic. On the one hand, riders' worried about injuries when crashing into these barriers is justified. On the other hand, riders might be protected from collisions with oncoming cars, from which reason ever.

Size of the problem, Scientific Background

According to the Department of Transport in the UK motorcycle crashes into crash barriers represent a small proportion of all motorcycle accidents, but a disproportionate number of motorcycle fatalities (Briefing on Wire Rope Safety Fence and Other Vehicle Safety Restraints (British Motorcycle Federation Briefing Paper, 2000).

A short survey of Austrian accident statistics clearly indicated that head-on collisions are the accident type with highest severity (2010: 17% of injury accidents involving motorcycles, 46% of fatalities). Drivers of oncoming cars are at fault for these accidents in at least on quarter of the cases.

Implementation

Technically, implementation of the 2+1 road is rather easy. Technical standards on wire rope barrier would have to be included in the national standards as a basis for contracting manufacturers. The barriers to implementation are largely concerns about impacts to PTW riders.

Expected Impact(s)

As indicated above, head-on collision account for a large share of - particularly fatal - PTW collisions. Except for some

The impact on the safety of motorcycle riders is questionable, but further research is necessary on the impact of wire rope barriers for different road users, especially for PTW riders.

Riders' perspective

★★★★★

The riders' associations strongly object to this measure because wire rope barriers are not designed to absorb the impact of a falling or sliding motorcyclist, and compared to other designs display a smaller area of contact, focusing the energy of the impact on a smaller area and causing gruesome and often fatal injuries.

Priorities

The expert rating is very low in particular in the category "efficiency". Hence, priority should be given to undertake additional research activities to determine, to which extent wire rope barriers affect PTW riders, in particular to assess potentially increased risk when hitting such a barrier against the benefit of being protected from oncoming vehicles.

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[15] Source: http://www.motorcyclenews.com/upload/205683/images/300x200/wirefence.jpg, 3 Aug. 2009

Under-ride Barriers for Guardrails

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★☆	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★☆☆
Efficiency	★★★☆☆	Sustainability	★★★★★

Guardrails are typically installed in corners, where leaving the road creates a serious risk to vehicles, e.g. if there is a steep slope beneath the road or if there are other obstacles, which need to be protected or cars need to be protected from hitting them. Hence, guardrails are beneficial for car users. But unfortunately, a very typical scenario for PTW accidents is losing control in a corner due to inappropriate speed or sudden braking maneuvers (which also may have their origin in inappropriate speed), too. Because of this, guardrails create additional risk to PTW riders, if they fall off their machine and slide towards the guardrail. In particular hitting one of the posts frequently results in very severe consequences. Thus, it is a fact that currently used guardrails are designed for the sake of car, truck and bus passengers but neglect PTW rider’s needs.

There are mainly four possibilities to encounter this particular risk:

- remove the guardrail
- mount protectors around the posts
- replace the guardrail with concrete barriers
- install under-ride protection

Finally, the definition of what kind of PTW protective device has to be installed on the safety barrier has the same importance as the location of the place where these devices have to be installed (this means the point in the curve where these devices have to be applied). Specific studies have been done defining possible locations where these devices should be applied.

Example:

Practically, improving guardrails is one of the most prominent PTW safety measures and there are many examples how to realize that. Many technical solutions and products are already on the market. Nevertheless, improvement of the European Standard for guardrails is still under discussion. There is neither a standard for testing guardrails upon suitability for PTW riders nor is there a standard which could serve as a basis for business cases (calls for tender) in most of the European countries except Portugal.

Improvement of guardrails is considered in many of the road safety programmes that have been reviewed in preparation of this volume, e.g. ACEM's Infrastructure Handbook.

ACEM (2006). Guidelines for PTW-safer road design in Europe, pp.38-40

Several products concerning “Motorcycle Protective Devices” (MPD) exist in different countries. Nevertheless, in each country these devices must keep the respective standards existing in those countries. Some examples of these devices are Spain

http://www.carreteros.org/normativa/barreras/barreras.htm

Sweden

http://epubl.ltu.se/1402-1617/2005/233/LTU-EX-05233-SE.pdf

and Australia

http://www.monash.edu.au/muarc/reports/atsb201.pdf.

Lastly, recommendations about the allocation of these devices (in which kinds of bends should be installed) are detailed in studies as “Orden Circular 18/04 y 18bis/08 sobre criterios de empleo de sistemas para protección de motociclistas” (recommendations about where to install MPD at Spanish National road network); document “Ministère de lÈquipement, des Transports et du Logement – number 99/68 1st October 1999” (recommendations for the French National road network); document

"Lei_33.2004 -"Colocação de protecções nas guardas de segurança das Vias de comunicação públicas, integradas ou não na rede Rodoviária nacional, contemplando a perspectiva da Segurança dos veículos de duas rodas" (recommendations for the Portuguese National road network). Spanish recommendations at National and Regional level are available at

http://www.carreteros.org/normativa/barreras/barreras.htm

Beneficiaries:

The measure is beneficial especially for PTW riders as it enhances passive safety by reconstructing guardrails.

Figure 17: Underride barrier[16]

Clear definition of the problem

The guardrail itself is designed to absorb the energy of a crash , but it does not offer any protection to a motorcyclist falling off a bike. If motorcyclists are sliding under the rail they could hit guardrail posts. This is a major cause of fatal motorcyclist injury. The current European standard for guardrails does not provide additional motorcyclist protection.

Size of the problem, Scientific Background

According to the Department of Transport in the UK, motorcycle crashes into crash barriers represent a small proportion of all motorcycle accidents, but a disproportionate number of motorcycle fatalities (Briefing on Wire Rope Safety Fence and Other Vehicle Safety Restraints. British Motorcycle Federation Briefing Paper, 2000).

Implementation

The legal requirements depict a barrier, as crash barriers or safety barriers have to meet a specific standard, which only requires testing with cars and heavy good vehicles, but not with motorcycles (European Standard EN 1317).

This type of accident is often not identified or reported, so the statistic evidence is biased.

Expected Impact(s)

There is an impact of under ride guardrails on the safety of motorcycle riders, but further research is necessary on the impact of guardrail barriers for different road users, especially for PTW riders.

Riders' perspective

★★★★★

The riders' associations strongly support this measure because it contributes to the reduction of accident severity, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

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[16] Source: http://home.arcor.de/csallner/html/mehrsi.html, 3 Aug. 2009

Priorities

Underride barriers are rather costly, however, they seem to be reasonable alternative to installing PTW-friendly protections systems, at least until the latter have been technically defined and impacts evaluated.

Guide Posts Made of Flexible Material

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★★★☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★★★★

Guide posts fulfill an important task concerning measures supporting the self-explaining nature of roads: They represent a cost-effective method to clarify the longitudinal roadway arrangement. But the more guide posts are dedicated to improve recognisability of a curve, the more possible obstacles are built to crash against. This danger could be avoided by placing guide posts made of flexible material instead of fixed ones.

Example:

This measure is recommended in “Motorrad fahren – auf sicherer Straße!” published by ADAC and DVR. If these guide posts made of flexible material are used, they hardly represent any obstacle as the risk of injury is minimized.

ADAC, DVR (2010). Motorrad fahren – auf sicherer Straße!, p.14

Beneficiaries:

The measure is beneficial especially for PTW riders as it enhances passive safety by placing flexible instead of fixed guide posts.

Figure 18: Guide posts made of flexible material[17]

Clear definition of the problem

A collision with sign post and poles is always safety critical for PTW riders. Severe or fatal injuries are caused by those fixed obstacles.

Size of the problem

The exact number cannot be quantified as the values vary strongly in several in-depth analyses. Whereas the importance of the problem is given, the size of the problem differs from area to area.

[17] Source: ADAC, DVR (2010) Motorrad fahren – auf sicherer Straße!, p.14

Scientific Background

Scientific evidence proving the benefit of this measure are amongst others the MAIDS study, several crash test data and crash reconstructions, the EU project RISER as well as the ERA-NET project IRDES. In these scientific papers, it is believed that the usage of flexible materials ensures a softer impact within the pole; that's why specific constructions (spring on the base of the pole, slip base, etc.) have been developed. In the case of a collision with the guide post, it depends on the impact speed, if the problem is fully targeted or not. In cases of high speed crashes the safety effect is often not proven.

Expected impact

This measure has an impact on road safety. Although the numbers quantifying the measure's effect are varying strongly, it is proven that in cases of crashes with those flexible posts, the severity rate will decrease. This positive effect as well as the success of this measure could be shown in dynamic simulations or in crash tests.

This kind of device should be tested using at least Head Impact Criteria (ECE 22.05).Some performance testing results provided by the manufacturer indicate the likelihood of reduced injury severity for PTW users striking the protected object. Nevertheless, this product is relatively new and not yet in widespread use.

Implementation

The barriers with regard to the implementation of this measure are higher costs for road authorities. Thus, the unwillingness of road authorities to implement forgiving roadsides, especially for PTW safety, has to be repealed.

Acceptance

As some road authorities simply do not know that measure, awareness must be raised. Besides, due to the fact that this measures targets just a small number of road users, more lobbying of motorcyclists associations as well as public campaigns in combination with media might help to raise acceptance.

Sustainability

It is supposed that no fading effects will occur.

Transferability

As injuries caused by this type of fixed obstacle are a global issue, the usage of guide posts made of flexible material is useful in all areas and for all road types.

Costs and benefits

For that case, a positive cost-benefit is not approved. Just on well known motorcycle routes (with black spots) the benefits can be identified.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to the reduction of accident severity, and helps create a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Expert rating are high in categories Transferability and Sustainability and quite good in terms of safety impact and efficiency. Hence, priority should be given to scientific proof of effects end efficiency before application on a larger scale.

6.4. Intersections

Reconstruction of Intersection Points

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★★★	Implementation	☆☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★☆☆☆
Efficiency	★★☆☆☆	Sustainability	☆☆☆☆☆

Intersections with high accident rates can be reconstructed with regard to the following issues: installation respectively clarification of speed limits, surveillance, reconstruction of the given lane structure and improvement of visibility.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. This drastic measure aims at decreasing the number of accidents at intersections due to turn-off maneuvers. Possible causes for such accidents were identified as following: Lack of understanding concerning the priority regulation, poor visibility of prioritized road users as well as missing turning lane for left-turning motorists.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.16

Some recommendations are given in guidelines detailed by different stakeholders about the design of intersections: Driver’s line of sight must be free of obstacles; uncontrolled right turn lanes at junctions; PTW sensitive detectors at intersections with traffic actuated signal control;…

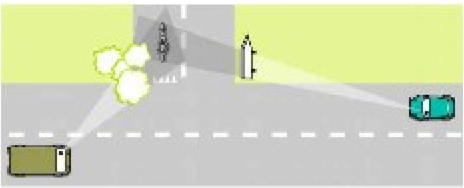

Figure 19: Visibility of PTW’s on intersections.

Guidelines from the Motorcycle Industry in Europe: ACEM “Guidelines for PTW-Safer road design In Europe”.

http://www.acem.eu/media/d_ACEMinfrastructurehandbookv2_74670.pdf

Guidelines from United Kingdom: IHE (Institute for Highway Engineers):

http://www.motorcycleguidelines.org.uk/mg_04_1.htm

Beneficiaries:

The measure is beneficial for all road users. However, accidents at intersection are a particular risk for PTW riders, whereby it is mostly the car driver’s fault. Most common accident causes are misjudgement of the PTW riders' speed or a perception failure, which is frequently linked with a PTW rider following behind a car.

Clear definition of the problem

Car drivers fail to recognize PTWs or fail to correctly assess their trajectory, leading to crashes.

Size of the problem

According to the results of MAIDS (2004), car drivers are the primary causation factor in over 50% of motorcycle accidents, and human error is the primary contributing factor in 87.5% of motorcycle accidents. Failure to recognize a PTW on the part of car drivers is a major accident factor.

According to the same study, 54% of overall powered two-wheeler accidents occur at intersections. Therefore, any successful effort at making intersections safer for PTWs will have a positive impact on motorcycle safety.

Scientific Background

The importance of clear, understandable intersections with adapted speed limits and good visibility is acknowledged by the working group "Motorcycle Accidents" set up by the FGSV. The measure is featured in the guidelines manual MVMot published by the working group.

Expected impact

As mentioned above, impacts at intersections feature prominently in PTW accident statistics. This is due to a variety of factors, among which the difficulty for some drivers to properly identify PTWs and assess their position, trajectory and speed. The measure will increase visibility, predictability, mutual recognition while making the behaviour of users more predictable. In particular, appropriate left-turn lanes (or right-turn lanes in left-hand drive areas) reduce the risk of both tail-end collisions, and head-on collisions with oncoming traffic, benefiting all road users.

Implementation

Barriers to the implementation of this measure include cost and lack of awareness. It is critical for the implementation of the measure that the general principles behind it are understood and applied within the framework of a comprehensive, systematic approach to a predictable and safe infrastructure design.

This can be achieved by integrating the measure into existing road safety audits, guides of best practice, road engineer training and the traffic code. On country roads it should be implemented in priority on motorcycle black spots, on motorcycle roads (as defined in the MVMot manual), and as part of a wider strategy aimed at improving all aspects of the infrastructure to increase PTW safety. In urban areas, it should be implemented alongside other measures (such as developed in the eSUM programme), and the guidelines disseminated to local and municipal authorities.

Acceptance

Concerns might be raised by road authorities bearing the expenses of implementation.

Sustainability

The measure is sustainable as long as its principles are maintained and improved, and it is not merged with incompatible principles when designing new infrastructure or maintaining existing intersections. As users get used to predictable intersections, the principles can be applied in other areas.

Transferability

Transferability is high, as the principles behind the measure apply to all types of intersection everywhere.

Costs and benefits

The cost of implementing the measure in new road designs or as part of improvement works is low, where reconstruction only for the purpose of reducing PTW accidents will be rather costly compared to other measures yielding similar results.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Priority should be given to apply improved design principles for any kind of reconstruction of intersections. Reconstruction should be considered particularly at high risk sites.

Entry Angle at Roundabouts

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	★★★☆☆
Total impact	★★★★☆	Implementation	★★☆☆☆
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	★☆☆☆☆	Sustainability	★★☆☆☆

In general, roundabouts have proved to be the most favourable way of designing intersections, if the limitations in terms of traffic density and design guidelines (diameter, width, etc.) are appropriately considered. Roundabouts reduce the number of potential conflict points as well as the driving speed and they improve the traffic performance of an intersection. However, there are particular needs for PTW riders, which need to be considered. An entry angle between 30° and 40° is recommended. Too high entry angles may lead to excessive deceleration which can result in tail end collisions, whereas a too low entry angles in contrast may hide a PTW from the view of drivers of other vehicles.

Examples:

The European Transport Safety Council (ETSC) published a guideline concerning safety measures for PTW riders in 2008 where specific entry angles at roundabouts are discussed.

ETSC (2008). Vulnerable Riders, pp.20-21

The national Guideline "Motorcycling in Scotland", published in 2007, also recommends paying attention to the entrance angles at roundabouts.

Scottish Motorcycling Community (2007). Motorcycling in Scotland, p.8

Beneficiaries:

Although this measure is proposed particularly for the sake of PTW rider safety, all vehicle classes benefit in a similar way for the simple reason that tail end collisions are avoided and PTW are less likely to be obscured by other vehicles.

Figure 20: Roundabout[18]

Clear definition of the problem

Inappropriate entry angles at roundabouts (<30° or >40°) compromise PTW user safety as they require a sudden deceleration on approach that may surprise other road users and cause tail-end collisions and compromise the visibility of PTWs by other users.

Size of the problem

According to the results of MAIDS (2004), car drivers are the primary causation factor in over 50% of motorcycle accidents, and human error is the primary contributing factor in 87.5% of motorcycle accidents.

[18] Source: ACEM (2006) Guidelines for PTW-safer road design in Europe, p.34

According to the same study, 54% of overall powered two-wheeler accidents occur at intersections. Therefore, any successful effort at making intersections safer for PTWs will have a positive impact on motorcycle safety.

Expected impact

Due to the high occurrence of collisions at intersections, the expected impact is high, with a decrease in accidents due to drivers failing to see the PTW, or tail-end collisions caused by the unexpected deceleration of the PTW. Furthermore, it will contribute to increasing the predictability of the road geometry for the benefit of all road users.

Implementation

Implementation will be most successful through the integration of simple principles governing the construction of roundabouts in infrastructure guidelines in different countries, into existing guides of good practices, and in the curricula of traffic engineering degrees. The guidelines should also be included in road safety audits, in order to easily identify undesirable configurations and eliminate them wherever possible.

Acceptance

The universal road user will hardly discuss about entry angles at roundabouts. Experts in road planning would have to be convinced by sound scientific evidence of the advantages.

Sustainability

The measure will be highly sustainable if integrated into guides of good practices. No risk compensation is expected.

Transferability

The measure is highly transferable in all countries that feature roundabouts, especially in urban areas.

Costs and benefits

The cost of implementing the measure in new road designs or as part of improvement works is minimal. The cost of reconstructing roundabouts displaying unsafe entry angles can be important. Reconstruction can be impossible altogether in some urban areas. If reconstruction is not feasible or pending reconstruction, the option of specific signage or speed limits warning motorcyclists about the roundabout ahead is available.

Riders' perspective

★★★★☆

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Priority should be given to evaluate the effects of this particular issue amoung road design principles.

6.5. Organizational and Restrictive Measures

Speed Limits for PTWs

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★☆☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	☆☆☆☆☆

Speed limits don't necessarily have to be the same for all PTWs. They can also differ with respect to vehicle classes and road types.

Example:

The Portuguese Highway Code has general principles applying to all road users (pedestrians, drivers and riders concerning vehicles, road use, etc.) and includes a specific chapter for PTW riders. Regarding PTWs, the code is centred on riding behaviour and it does not include other domains. Particular speed limitations are also included in this national guideline (Decree-law number 44/2005, implemented in 2005):

Motorcycles:

- Urban areas - 50 km/h
- Motorways - 120 km/h
- Roads reserved to cars and motorcycles - 100 km/h
- Other roads - 90 km/h

Mopeds:

- Urban areas - 40 km/h
- Other roads - 45 km/h

http://www.prp.pt/informacao/actualidades/act_00107.asp

Beneficiaries:

As speeding is one of the major contributing factors to motorcycle collisions, speed regulations aim at reducing the total number of accidents as well as the accident severity. The measure is addressed to motorcycles and mopeds.

Clear definition of the problem

Motorized road users exceed the speed limit and endanger themselves and other road users.

Size of the problem

Speeding is a major contributor to almost all crashes. Speed can be considered as one of the biggest road safety problem.

Scientific Background

The associations between travel speed, impact speed and injury risk are well known (Oxley, 2007). Higher speed reduces a rider's ability to control the PTW, negotiate curves obstacles in the roadway and increase the chance of running off the road or into an on-coming vehicle. Higher speed also reduces the time available to avoid a collision, it increases the severity of the impact in a collision and additionally it increases unpredictability of the rider to other road users.

Reducing the speed level in general is one of the most important contributing factors to enhance road safety.

Expected Impact(s)

This measure will have an important effect on road safety, but only if the speed level is reduced for PTW riders AND car drivers – it does not make sense to reduce the speed level only for PTW riders.

A decreasing number of road fatalities, severe injuries and traffic accidents will indicate that speed limitations for all motorized road users are a well working measure.

Impact on environment (noise disturbance): 20 km/h less halve noise disturbance, Ewert 2010.

Implementation

The adherence of speed limitations is crucial; therefore it is necessary to guarantee that they are observed. If the infrastructure provokes speeding (e.g. because of broad roads); without sanctions this measure won't work. Also the awareness of road users and authorities that speed is a key factor in road safety has to be raised.

Acceptance

Speed limitations are unpopular in general. They are considered as a restriction of personal freedom. Riders as well as authorities will resist special speed limitations resp. the observation of the adherence. Riders strongly interfere with any speed limits exclusively applied to them.

Sustainability

More research is needed to determine the feedback of riders to speed limits exclusively applied to them. Poor ratings by experts might consider the fact that riders are likely to ignore such speed limits.

Transferability

It is rather easy to place signpost with a speed limit almost anywhere.

Costs and benefits

Costs are considered rather low, benefits seem to be questionable.

Riders' perspective

☆☆☆☆☆

The riders' associations strongly oppose all discriminatory measures against riders, including this measure, because it will create additional hazards to motorcyclists by forcing them to behave differently from the rest of the traffic flow, making their behaviour less predictable and more confusing to other road users.

Priorities

According to comments and expert judgement, speed limits exclusively valid for PTW riders should not be considered a solution to a safety problem.

Speed Limits at Hazardous Sites

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★★☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★☆☆☆
Efficiency	★★★★★	Sustainability	★★☆☆☆

Speed limits at dangerous spots or sections are supposed to reduce the riders' risk of losing control of his PTW. Such speed limits are installed at curves with an inconsistent radius or before a series of curves. Most guidelines also recommend the strict surveillance of these speed limits.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. FGSV suggests that the speed limits should be controlled either on the basis of radar or laser as well as with the help of video surveillance. Besides, the speed controls could also be carried out by police officers.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.16

Beneficiaries:

The measure is beneficial for all road users, as it reduces the speed and consequently the number of accidents due to speeding at dangerous sites. However, this measure might be particularly useful for PTW riders since the measure is likely to be used at road sections which represent a particular risk to PTW riders.

Clear definition of the problem

Motorcyclist are overrepresented in fatal motor vehicle crashes. Nevertheless they believe in their ability to control their riding experience. The results of FGIs (Natalier, 2009) indicate that speed limits are often not observed by the motorcyclist.

Size of the problem and Scientific Background

Hatfiled (2007) states that speeding is recognized as an important contributor to road crashes, increasing both the frequency and severity of road crashes. Between the years 2000–2002 speed was identified as a contributing factor in one third of all fatal crashes in the US. In the study about the motorcyclists interpretation of risk and hazard Natalier (2009) found that motorcyclists attempt to marginalize the risk of motorcycling, even when they have knowledge of the statistics. Motorcyclists consider their “embodied experience” as a crucial element of control. Further Natalier writes that “legislatively defined speed limits can be understood as a definition of what is safe and acceptable on a particular stretch of road.” Motorcyclist rather tend to reject such manifestations of expert systems. The own speed is not predominately perceived as an important contributor to road crashes (Natalier, 2009).

Implementation

The aspect that speed limits are often not observed, as they are not perceived as an important crash preventive factor, might be a barrier for a successful implementation.

Expected Impact(s)

This measure will have an impact on the safety of all road users, especially vulnerable road users.

Higher speed causes higher emission of polluting NOx, a reduction of the speed level therefore will also have a positive effect on the environment.

This measure will reduce motorcycle rider fatalities, as described above one third of fatal motor vehicle crashes in a two years period are related to high speed.

Acceptance

Reducing speed limits is a rather unpopular measure, but it is an effective one. This positive impact has to be stressed. Research has shown that speed limits are accepted where they are plausible.

Sustainability

The observance of the speed limits has to be enforced and non-observance has to have immediate consequences, depending on extend and frequency of non-observance (behaviour training, fines, etc.)

Transferability

It is rather easy to place signpost with a speed limit almost anywhere. Low ratings might result from the fact that it is rather difficult to communicate the reason for a speed limit on a signpost and riders (just like other road users) are likely to ignore speed limits, where the reason for them is not recognisable.

Riders' perspective

★★★★★

The riders' associations support this measure, as long as the speed limits are adapted to the conditions on the site and intended to improve rider safety, because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

This is a high priority measure given the particular danger of a site treated by a speed limit is obvious. For hidden risk, other treatments will be more reasonable.

Ban on Passing

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★★★☆
Total impact	★★☆☆☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★☆☆☆☆
Efficiency	★★★★★	Sustainability	☆☆☆☆☆

Similar to speed limits, passing can be banned at hazardous sites because in longitudinal traffic, accidents are often caused by risky overtaking maneuvers. To avoid accidents of this type, bans on passing are being conducted.

In combination with this measure, longitudinal highlighting of road markings is recommended, too.

Example:

The measure originates from the national motorcycle guideline “Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken” published by FGSV. This of measure particularly aims at decreasing the number of accidents at intersections in longitudinal traffic.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.16

According to FSV, bans on passing respectively longitudinal highlighting of road markings can also reduce the number of accidents in curves, which are caused by a road user who is cutting the corner.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.6

Beneficiaries:

Although it is mentioned in a motorcycle safety program, the measure is also beneficial for other road users, as it has the potential to reduce the overall accident numbers, if appropriately applied.

Figure 21: Ban on passing[19]

Clear definition of the problem

In longitudinal traffic, accidents are often caused by risky overtaking manoeuvres. To avoid accidents of this type, bans on passing can be conducted.

[19] Source: http://www.wien-heute.at/iddb/archiv800/lo_62_archiv800_24581.jpg, 24 Aug. 2009

Size of the problem

Depending on different studies there is a proportion of accidents that involve PTWs making inappropriate passing manoeuvres when there is on-coming traffic on the opposite direction, or at bends etc.

Scientific Background

The implementation of this measure can be supported by the proportion of accidents caused by the PTWs making inappropriate passing manoeuvres when there is on-coming traffic on the opposite direction, at bends etc.

This measure if implemented eliminates all such accidents.

The measure targets the identified problem to a high extent.

Implementation

Acceptability of PTW riders might be rather low, and if there is no enforcement the measure is difficult to be followed.

PTW riders might argue that in certain case even if situation seems risky it might be riskier not to make a passing manoeuvre.

This measure should not make any discrimination between different road users. It should only be applied at high risk sites instead of being considered a universal measure of precaution at potentially dangerous sites.

Expected Impact(s)

The measure will reduce the number of the relevant accidents, if followed by the PTW riders.

No such evaluations have been done in 2BESAFE that provide evidence of the impact of this measure.

A before and after study of accidents or conflicts in the specific locations could take place. In addition, the measure acceptance should be measured by monitoring the sites and recording the proportion of riders that do make passes even if it is forbidden.

Risk compensation is an issue especially if a rider becomes irritated by not being able to make the pass. A HGV is in front of the PTW and is moving slowly whilst producing HGV emissions, once the PTW makes the pass might ride more aggressively.

Acceptance

- A proportion of riders are expected not to accept it as it will make their trips longer time-wise.
- Other road users are expected to accept the measure.
- Acceptance by legislative bodies depends on the location of the bodies (North Europe/South Europe), the population of PTWs and the importance of popularity vs. road safety.

By showing statistics where the evidence indicates high fatality rates in such cases, mainly or by promoting it via motorcycle clubs. However, the anticipated mentality of each rider would be “this will not happen to me and is a problem for others”.

If riders are persuaded that this issue concerns them as well, they will be easily persuaded that the measure will be effective.

Sustainability

There might be a risk of risk compensation, hence riders who would perform passing manoeuvres and do not due to the ban, might drive more aggressively when they can.

Transferability

The implementation of the measure can be done in any area where it promotes road safety. However, depending on the mentality of the rider population (which also depends on the region/country) enforcement will be needed for the measure to be effective.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★☆☆☆

The riders' associations support this measure, as long as the bans on passing are adapted to the conditions on the site and intended to improve rider safety, because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

This is a measure that is easy to implement, however enforcement and information of the riding population is necessary for its success. However, its priority depends on the actual number of accidents for which one the predominant factors is passing in the respective areas/countries.

6.6. Measures for Urban Traffic

Use of Bus Lanes by PTWs

Expert Assessment			
Overall		★★★☆☆	
Size	★☆☆☆☆	Transferability	★★☆☆☆
Total impact	★★★★★	Implementation	★★★★☆
Safety impact	★☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	★★★★★	Sustainability	★★☆☆☆

Either by legal provisions or case-by-case legislation, other vehicles than busses can be allowed to use bus lanes. E.g. it is quite common to entitle bicycle riders, taxis, high occupancy vehicles to use lanes primarily reserved for public busses. It may be supposed that PTWs using bus lanes do not obstruct busses, since they can, in case, give way by filtering into other lanes. Beyond that, they would be less of an obstacle than bicyclists since travelling at higher speeds.

Examples:

This measure is recommended e.g. by the transnational ETSC guideline for vulnerable road users. Furthermore pilot projects have been conducted in Stockholm and the UK several years ago. Meanwhile the use of bus lanes by PTWs is allowed at several sites in the UK and Austria at several conditions.

ETSC (2008). Vulnerable Riders, p.23

Transport for London has recently issued a study on PTW on bus lanes and its results indicate that there is a not statistically significant safety benefit concerning collision rates for all vulnerable road users (PTW riders, cyclists, pedestrians, bus occupants). Since 5 January 2009 another trial for the use of bus lines by PTWs has been conducted in London.

http://www.tfl.gov.uk/roadusers/finesandregulations/10151.aspx

In South Gloucestershire, motorcycles are permitted to use all bus lanes where taxis are also permitted. The use of high occupancy ("2+") lanes by PTWs is also allowed in South Gloucestershire.

http://www.southglos.gov.uk/NR/exeres/5808c395-7ae7-4e4c-96a1-6ee032c7f124

A pilot was also carried out in Vienna. Three criteria were set up for bus lanes to be used by PTW riders:

- no pedestrian crossings without traffic lights
- no oncoming left-turn traffic
- no induction loops for governing traffic lights

Three bus lanes in Vienna fulfilled these criteria, the evaluation was somewhat successful. There were no PTW accidents (when the bus lanes were already used by PTW riders illegally) before and no PTW accidents after implementation. Meanwhile two more bus lanes were opened for PTW riders.

Beneficiaries:

This measure primarily aims at privileging PTW riders and improving their mobility without harming any other road users. However, being allowed to use the bus lane for PTW riders also means not having to share the lane with cars and trucks, possible even not having to move between queues of busses and trucks and therefore it is relevant for safety as well. Because this way, the main accident configuration of car/PTW accidents could be influenced positively as traffic conflicts will be reduced through separation.

Figure 22: Use of bus lanes in London[20]

Clear definition of the problem

There is no problem related to safety for this measures, it just promotes PTW mobility and makes trips shorter time-wise.

Size of the problem

PTW travelling times are reduced at a high extent especially in road environments where filtering or lane splitting are not allowed and where traffic is dense.

Scientific Background

There is no need for scientific evidence on this measure to prove it increases PTW mobility. Some might argue that this measure might increase accidents either between PTW and buses. However, in cases where this has already been implemented there was no such issue.

As noted this measure will work only in cases where filtering or lane splitting are not allowed and where traffic is dense, hence all vehicles including PTW would drive at lower speeds than those that PTW could drive at if using bus lanes.

The extent which the measure targets PTW mobility depends on traffic conditions, and laws involving filtering and lane splitting.

Implementation

The bus lane should have adequate width, PTWs should not be allowed to ride in the far right section of the lane as possible conflicts/accidents might happen with bus passengers at bus stops.

The road environment where this practice is allowed should be taken into account as well as the speeds of busses and bus density of the bus lane. If this is high there is no point of implementing the measure.

[20] Source: http://www.tfl.gov.uk/roadusers/finesandregulations/10151.aspx, 12 Aug. 2009

It might be the case that in bus lanes where bicycles are allowed, PTWs should not be allowed as there are three types of vehicles with distinct characteristics and this makes the situation somewhat risky.

Awareness can be raised mainly from media and PTW and bus associations.

Expected Impact(s)

This will have an impact on PTW mobility, and hence might reduce slightly environmental pollution.

Depending on the traffic conditions and road environment it can reduce PTW travelling times.

There are no such evaluations done in 2BESAFE that provide evidence of the impact of this measure.

The number of PTWs using the bus lane before and after implementation can be a measure of success. In addition, the number of accidents taking place in the bus lanes where PTWs are involved before and after implementation will also indicate the measure's risk.

Results from this measure in London shows that the assessment of PTW collision numbers showed six out of eight analyses as being beneficial to the safety of PTW riders. Other results related to this good practice were that PTW use of the bus lane did not lead to an increase in collisions; or PTWs in bus lanes do not significantly affect the journey time of buses; and finally, the number of PTWs using the route during bus lane operation times increased 200-400%.

Acceptance

This measure will be accepted by riders.

It might not be accepted by other road users using the bus lane (buses, bicycles).

The acceptance of legislative bodies (i.e. politicians, public administration) depends on the region, and the driving mentality of riders and bus drivers mainly.

This measure promotes PTW travelling times; other road users might not accept the measure, as they might be concerned with PTW manoeuvres that will cause conflicts. Hence, the "problem" that is dealt with this measure is less important than road safety for them.

Accident statistics in cases where this practice is applicable could show whether the movement of PTW in bus lanes can be a problem or promotes PTW mobility without any shortcomings.

Sustainability

The increase of riding flexibility and the anticipated effect on riding time will not fade with time.

Transferability

The implementation could be done in any country. One would expect better results if road filtering and splitting is also allowed. In addition, in countries where drivers respect the rules and drive in a careful way, again the measure will be more effective.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations strongly support this measure because it increases the efficiency of PTWs in easing congestion, without creating additional risk or disrupting bus and taxi traffic.

Priority

Low priority should be given to this measure if road safety is concerned. However, in cities with congestion problems this measure could improve traffic conditions.

Separate PTW Lanes

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★★★★	Implementation	☆☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★★☆

Provision of separate lanes where there are large numbers of PTWs can reduce the potential for conflicts with larger vehicles. PTW lanes can either be ‘inclusive' or ‘exclusive'. Inclusive means that the PTW lanes are installed on the existing road and are usually located on the outside of the main carriageway for each direction of traffic flow. PTW lanes may be separated from the rest of the road by painted lines or physical barriers. At intersections, inclusive PTW lanes rejoin the main carriageway and crashes can occur. By contrast, exclusive PTW lanes require a carriageway completely separate from that used by other vehicles, which minimizes crashes at intersections.

Example:

Malaysia built the world's first exclusive motorcycle lane on Federal Highway 2 in the 1970s as part of a World Bank project. A review of the lanes found that there had been a 39% reduction in motorcycle crashes as a result of fewer conflicts between motorcycle and other vehicles, also a lower speed differential between vehicles. Since this first motorcycle lane was installed, many more have been installed along several of the other Highways in Malaysia.

Malaysia has also made extensive use of inclusive motorcycle lanes. They are built along Federal trunk roads where access to and from the lanes is not controlled. Research found that there is a reduction in motorcycle crashes on roads where inclusive lanes are installed. However, there seems to be an increase in pedestrian crashes where pedestrian traffic is prevalent. This may be due to the increased overall width of the road. Features like pedestrian refuges can help avoid these crashes.

http://toolkit.irap.org/default.asp?page=casestudy&id=4

Beneficiaries:

As PTWs are separated from the other road users, especially from heavy vehicles, motorcycle as well as moped accidents can be reduced. Because this way, the main accident configuration of car/PTW accidents could be influenced positively as traffic conflicts will be reduced through separation.

Figure 23: Inclusive motorcycle lane[21]

[21] Source: http://toolkit.irap.org/default.asp?page=casestudy&id=4

Clear definition of the problem

Conflicts between other road users and PTWs are quite common both inside and outside urban areas. The separation of the users with the provision of separate PTW lanes, would reduce the number of conflicts and hence, of multi-vehicle accidents.

Size of the problem

In different cases and environments several PTW accidents take place between PTWs and other vehicles in road environments. However, usually their severity is not that high in urban areas. In areas with high speeds such accidents are usually more severe. In addition, in urban areas with dense traffic where filtering and lane splitting are not allowed separate PTW lanes might also offer higher mobility of PTWs.

Scientific Background

The scientific evidence can be provided by the number of PTW-other road users' conflicts or accidents when these road users are moving adjacently.

This measure will result in avoiding such accidents. However, enforcement is required for its success.

The measure targets the identified problem at a high extent.

Implementation

Barriers involve lane width, and the issue of the lanes being inclusive or exclusive in specific environments.

Critical issues to be considered involve whether there are right or left turns on the road which requires a setting of rules and management of PTWs' and other road users' interactions.

The existence of complex interactions between PTWs and other road users (vehicles and pedestrians) should be avoided.

Awareness can be raised mainly through media and training schools.

Expected Impact(s)

This measure will have an impact on PTW road safety, mobility and hence a slight one on environmental pollution in urban areas with dense traffic.

The number of PTW and other road users interactions will be reduced.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

There are two ways to estimate the measure's success. A before and after accident study and the investigation of the causational factors of PTW-other road users accidents.

No side effects are expected.

Acceptance

The acceptance of PTW riders depends on the types of roads where the measure is applied and on whether the lanes will be inclusive or exclusive. If PTWs are only allowed to use these lanes (except of course at intersections) this measure is not anticipated to be accepted by PTW riding population especially in areas with high percentages of motorcycles and high traffic volumes.

Other road users will be in favour of this measure if this does not cause for them additional travelling times and especially in highways, freeways etc.

Infrastructure providers might not be in favour of the measure as this means additional investment.

Acceptance by legislative bodies (i.e. politicians, public administration) depends on the area where the measure is implemented, the accident statistics, and the riding population.

Clear definition of the solution together with accident statistics might show that the interaction between PTWs and other road users causes conflicts and potential crashes and hence reduces road safety.

The measure can be effective and this can be proven by indicating that in a number of accidents, PTW and other road users interaction within the same or adjacent lanes is one of the predominant factors.

Sustainability

In general risk compensation might take place as riders – in case of low traffic volumes – might ride with higher speeds in highways, freeways etc.

Transferability

This measure can be implemented anywhere however, it should be respected both by PTW riders and other road users to be effective. In addition, it should be examined in a case-by-case way, taking into account type of road, accident statistics, population of PTW riders on the particular road etc.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★☆

The riders' associations strongly support this measure because it increases the efficiency of PTWs in easing congestion and improves the safety of PTWs, especially in heavy traffic areas or for small scooters and mopeds along road sections where their low top speed could put them at risk.

Priority

The priority of the measure depends on the number of accidents in each area and the type of road and riding population. For example in roads with medium-low traffic volume where vehicles travel with high speeds and a substantial number of accidents between PTW and other vehicles takes place high priority should be given. In addition, in urban areas with high traffic volumes and high number of PTWs and where drivers/riders in general respect traffic rules this should also be examined.

Moving Mopeds from the Cycle Lane on the Carriage Way

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★☆☆☆

The separation of different road user groups should avoid traffic conflicts among them, which is particularly relevant if road users travel at strongly differing speeds. By granting mopeds access to bicycle paths, the conflicts related to the speed difference between these two road user groups should be avoided. But in fact, the number of conflicts and crashes increases at junctions as the moped rider, who is leaving the bicycle path, is overlooked or his speed is misinterpreted.

In cases where mopeds are allowed to use the cycle lane they will be now not be allowed to used anymore instead they will be moving on the road with the rest of the motorized vehicles especially at urban road networks.

Example:

In the Netherlands, until December 1999, mopeds had the same status on the road as cyclists in respect of bicycle path use. Thus, many crashes occurred at junctions because moped riders rode on bicycle paths at a higher speed than expected, and were noticed too late or not at all. For that reason, moped riders have been required since 1999 to ride on the carriage way in urban areas. A year after the introduction of this measure, it was found that the number of crashes involving mopeds and light mopeds in urban areas had fallen by 31%. About half of this decline (15%) was the result of this measure; the other half (16%) could be ascribed to the general decline in casualties among moped and light-moped riders.

http://www.swov.nl/rapport/Factsheets/UK/FS_Moped_riders.pdf

Beneficiaries:

This measure is beneficial for moped riders and contributes to a decrease of the number of moped crashes.

Clear definition of the problem

Separation of different road users, especially if they have different movement characteristics (mainly speed) can create conflicts. In addition, the number of conflicts and crashes increases at junctions as the moped rider, who is leaving the bicycle path, is overlooked or his speed is misinterpreted.

Size of the problem

The different speeds between those different transport modes which use the same dedicated lane seems to be a causational factor for moped accidents.

Scientific Background

In the Netherlands this measure was implemented and after a year a reduction of accidents of about 15% was attributed to this measure.

Apart from the scientific evidence that exists in previous examples (in the Netherlands) and apart from the fact that in several countries are not allowed to use the cycle lanes, it is considered to be best to have motorized traffic having as little interaction as possible with non motorized traffic.

This measure targets directly the aforementioned problem.

Expected impact

This measure is expected to have an impact on road safety but also on moped mobility (i.e. travelling times).

The measure will reduce road safety accidents where mopeds are involved (is such situations) and moped travelling times.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

An evaluation of this measure would be a before and after accident study in intersections/areas where mopeds were using the cycle lane where involved in accidents.

No side effects are anticipated.

Implementation

Barriers implementing this problem can be the low speed of specific mopeds.

Critical issues when considering the problem is to check what are the speeds in the road network. If these are too high, then the inclusion of mopeds in the carriageway might be riskier.

It should be best to avoid having this measure implemented only in specific sites.

Awareness can be raised through driver training schools and the media.

Acceptance

Riders mainly moped riders will accept the measure, motorcycle riders travelling with higher speeds might not be that enthusiastic about the measure.

Other road users might not be very enthusiastic about the measure as this might result in lower travelling speeds for them, but they will accept it.

Industry will be indifferent to the measure.

Educational bodies (schools, driving schools, etc) will accept the measure, but may require to modify the current rules for riding a moped and ask for actual training of potential moped riders.

Infrastructure providers will probably be indifferent to the measure.

Legislative bodies (i.e. politicians, public administration) will probably be in favor of the measure, however it might be required that a modification of the current rules for riding a moped and involving actual training of potential moped riders.

This measure is expected to be accepted by all groups unless it is implemented in roads with rather high speeds.

The measure can be demonstrated as successful by showing accident statistics where mopeds using the cycle lanes are involved, and explaining why the separation of slower moving transport modes (bicycles) from faster motorized ones (mopeds) would result in avoiding such accidents and not creating different ones.

Sustainability

The measure is not expected to have fading effects.

Transferability

Implementation of this measure is possible only where moped riders are obliged to use the cycle lane.

Different effects could be expected between South and North European countries, however in most places mopeds are not allowed to move in cycle lanes especially in the South of Europe.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

(no comment)

Priorities

This measure should not be of high priority unless many accidents take place. Although the measure was proved to be effective, it receives a very low rating, which might be due to the fact that there is hardly any place where moped riders are either allowed or even obliged to sue the cycle path.

Advanced Stop Lines for PTWs

Expert Assessment			
Overall		★★★☆☆	
Size	★☆☆☆☆	Transferability	★★★☆☆
Total impact	★★★★★	Implementation	★★★★☆
Safety impact	★☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	★★★★☆	Sustainability	★★★★★

This measure involves the design of two distinct stop-lines at an approach of a signal controlled junction; the upstream one being for all vehicles and the downstream one only for PTWs (or bicycles). Pedestrian crossing is placed downstream of the PTW stop-line. The measure should be accompanied with the permission of filtering (see chapter 12 – Traffic Law and Enforcement).

Example:

The measure can be found e.g. in the transnational guideline "ACEM Guidelines for PTW-safer Road Design in Europe".

ACEM (2006). Guidelines for PTW-safer road design in Europe, pp.51-52

Two stop lines at large intersections with the front line reserved for two-wheelers have been introduced in some Belgian, Dutch and Swiss towns.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.150

In April 2011, the National Assembly of Austria decided that the implementation of advanced stop lines for riders of two-wheeled vehicles was legal.

http://www.parlament.gv.at/PAKT/VHG/XXIV/I/I_01135/fname_212499.pdf

Beneficiaries:

This measure is particularly addressed to PTW riders, however, bicycle riders could benefit as well. PTW riders normally leave an intersection much faster than passenger cars and trucks, as soon as the traffic light turns green. Without advanced stop lines they would have to queue up in between the cars and trucks also waiting for the traffic light to turn green. This creates dangerous situations, a process of filtering into the queues of cars has to take place or the PTW riders remain between the cars which would be the most dangerous variant.

This measure may be considered both as a safety measure and a measure towards improving PTW mobility, which does not harm any other road users.

Figure 24: Example of advanced stop lines for PTWs[22]

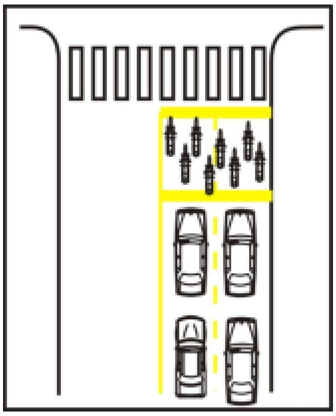

Figure 25: Illustration of advanced stop lines for PTWs[23]

Clear definition of the problem

PTW's have usually higher accelerations and hence move quickly at faster speeds from stationary than other motorized traffic. Not allowing them to be at an advanced stop-line results into having more interactions with the rest of the traffic (hence more potential conflicts) and to them not being able to exploit the kinematics of their vehicle.

Size of the problem

There will be a smaller number of conflicts between PTWs and other road users at the start of green, PTW travelling time will be reduced and road capacity will also increase.

Scientific Background

Sermpis et al., (2005) found an increase in road capacity when advanced stop-lines are implemented together with allowing filtering.

[22] Source: ACEM (2006) Guidelines for PTW-safer road design in Europe, p.52
[23] Source: Winkelbauer, KfV

This measure will work as there will be less interactions of moving traffic between PTWs and other road users and PTWs will not be “in the way” of other vehicles and will proceed faster downstream allowing for higher capacity.

The measure targets directly the described problem.

Expected impact

The measure is expected to have an effect on safety, mobility and environmental conditions.

Motorcycle travelling times will reduce especially but only if filtering is allowed, road capacity will increase and moving PTW and moving other road users’ interactions will also reduce.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

This measure can be evaluated through simulation in terms of PTW mobility and road capacity.

There are no side effects.

Implementation

Not allowing filtering and not having enough space in the lane width are barriers for implementing the measure.

The aforementioned issues should be taken account as they are critical. Not permitting filtering will make the measure ineffective.

There are no other things to avoid when implementing the measure.

Awareness can be raised through the media and training schools.

Acceptance

Legislative bodies (i.e. politicians, public administration) will be in favour of the measure especially in urban areas with a high composition of PTWs and dense traffic conditions with the only barrier being the attribution of fault when an accident happens during filtering.

This measure will probably be accepted by all groups, as it promotes both safety and mobility. Scientific evidence can be shown that this measure is an effective one.

Sustainability

The measure is expected to be sustainable through time.

Transferability

The implementation of the measure is possible anywhere, but is effective mainly where the traffic is dense and the composition of PTWs is high.

The implementation is possible in Europe in areas where the aforementioned conditions exist.

The measure will have different effects depending on the traffic flow and PTW traffic composition.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations strongly support this measure because it increases the efficiency of PTWs in easing congestion and improves the safety of PTWs, especially in heavy traffic areas; and because it contributes to the safety of all users by segregating two-wheel and four-wheel vehicles at intersections to avoid conflicts or perception errors.

Priorities

The measure should be given high priority in areas that will benefit from it.

PTW Parking within Intersections

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★☆☆

PTW parking within intersections means that at dedicated intersections, the restriction concerning the general parking prohibition within the intersection is lifted for PTW riders. But if parking within an intersection is permitted for PTW riders, the vehicles should be parked parallel to the sidewalk to avoid any line-of-sight obstructions.

Example:

In Austria, it is being discussed if PTW parking within dedicated intersections should be permitted in Vienna.

Beneficiaries:

This measure benefits PTW riders as well as all the other motorists: Especially in cities with a high number of motor vehicles, free parking lots are rare. Thus, if PTW riders parked their moped or motorcycle within intersections instead of parking places, this problem could possibly be solved. But it also has to be considered that pedestrians could be hindered when crossing the street due to parked PTWs.

Clear definition of the problem

The main problem is that of finding parking space for road users in dense urban areas. Another problem in certain countries (eg Greece) is that since parking is not that easy to find, PTWs use the pavement to park, which is illegal.

Size of the problem

Parking time for all road users will be reduced.

Scientific Background

There is no scientific background according to our knowledge.

This measure saves time for PTWs as it allows only them to park at dedicated locations, where they were not allowed to. In addition, it saves space, so other road users will find parking space easier and hence in less time.

The measure targets the problem to a medium degree.

Expected impact

PTW and other road user mobility and environmental conditions.

It will reduce PTW and other road users searching for parking times.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

A before and after study would indicate the measure’s success however its success also lies on whether the PTWs park only horizontally and no other road users use these parking slots, and on whether the traffic moving next to the pavement is not influenced by the new addition, simulation could also be used for parking times and emissions.

Only side effect is that the parking slots are not used in the designed manner.

Implementation

A barrier of implementing this measure is the lane width, it should be adequate to serve both existing traffic and the parking space.

Critical issues to be considered involve the lane width, the markings should be clear and indicate that only horizontal parking is allowed, they should be placed (especially if there are turns in the intersections) in appropriate length upstream of the intersection.

Having no enforcement in these areas might involve PTWs parking also vertical to the pavement to save space, or because they only found so little space.

Awareness can be raised through training schools, the media, and campaigns.

Acceptance

All groups will be in favour of the measure (or at least indifferent) as long as the parking slots are designed efficiently and used in the correct manner.

There is no such problem for this measure if the aforementioned conditions apply.

Sustainability

There are no fading effects of this measure. And if there are PTW rider disobedience to the rules, police enforcement can “fix” this problem.

Transferability

The implementation of this measure is possible anywhere (expect probably for networks with high speeds) but it is efficient in areas where parking is a problem and there is a high proportion of motorcycles.

The implementation is possible anywhere in Europe taking into account the aforementioned conditions.

The measure is expected to have different effects. Countries where traffic rules are obeyed will have a better result, than countries where traffic rules are disobeyed and in this case PTWs might also park vertically, or two at one slot, or the slots be used by other road users.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★☆

The riders' associations strongly support this measure because it increases the efficiency of PTWs in easing congestion and reducing pressure on parking space in cities.

Priorities

This measure provides a solution only to limited number of problems in availability of parking space.

Shared Space

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	☆☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★☆☆☆☆

Shared Space is a relatively new concept emerging across Europe. It encapsulates a new philosophy and set of principles for the design, management and maintenance of streets and public spaces, based on the integration of traffic with other forms of human activity. The most recognizable characteristic of shared space is the absence of conventional traffic signals, signs, road markings, humps and barriers. The driver in shared space becomes an integral part of the social and cultural context, and behaviour (such as speed) is controlled by everyday norms of behaviour.

This concept implies more than simple design techniques. It also requires an innovative approach to the process of planning, designing and decision-making. New structures for municipal organization and public involvement are the result. Shared space offers a basis for addressing safety issues, for overcoming community severance, for tackling congestion and for enhancing economic vitality in streets and public spaces.

http://www.shared-space.org/

Example:

Shared space has been implemented at some sites mostly in the Netherlands. Since the name is protected, similar layout is applied elsewhere using no or a different name.

Beneficiaries:

Shared space is not a safety measure. It is a design principle, certainly with different risks for different groups of road users compared to conventional roads; but without any particular impact to PTW riders.

Clear definition of the problem

This measure targets road safety and congestion (hence also environmental conditions).

Size of the problem

There is no evidence of what size of the problem shared space addresses as it is still a new concept. However, we are of the view that this is not an effective measure.

Scientific Background

There is no scientific background on this measure.

This measure does not seem like a safe measure to be implemented.

This measure does not target the identified problem, as it might only be implemented with success in specific and small areas, with people with specific mentalities.

Expected impact

The impact to PTW riders remains unclear.

Transferability

This measure might only be possible to be implemented in a small number of specific areas.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★☆☆☆☆

The riders' associations recommend more research into the effects of this design on safety and road user behaviour. Since in most collisions between PTWs and passenger cars the car driver is at fault due to overlooking the rider, this design could confuse drivers and increase the number of accidents.

Priorities

In terms of solving PTW-related problems, Shared Space seems not to provide reasonable benefits.

6.7. Pavement

Skid Resistance: Magnitude and Consistency

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★☆☆☆☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★☆☆☆	Sustainability	☆☆☆☆☆

Concerning PTWs, losing grip (exceeding the available friction forces by applying acceleration, deceleration or centripetal forces) between tire and road surface mostly entails skidding and the rider falling. Hence, PTWs are much more depending on predictable, constant friction of the road surface than four-wheel vehicle.

Example:

The provision of consistent road surfaces is recommended e.g. within the “IHIE Guidelines for Motorcycling” published by the Institute of Highway Engineers in 2005, but also mentioned in many other safety programs guidelines and recommendations. Some recommendations are given about pavement condition surveys and skid resistance; surface contamination and debris; rutting; re-texturing and materials.

IHIE (2005). IHIE Guidelines for motorcycling – improving safety through engineering and integration, p. 51

Beneficiaries:

Consistent, predictive and high friction surfaces are beneficial for all road users. However, they are particularly important for all PTW riders. The measure is especially effective against single vehicle accidents in curves on rural roads. It affects accident numbers but is hardly affecting crash severity. On the contrary, high friction might encourage riders to choose higher speed. If they lose control then, the consequences might be even more severe than on road surfaces in poor condition. Hence, focus has to be put on predictive and consistent friction instead of high friction.

Figure 26: Inconsistent road surface[24]

Clear definition of the problem

Inadequate skid resistance will lead to higher incidences of skid related accidents. Wet roads, slippery road surfaces or road markings are a severe problem for motorcyclist as the bike runs the danger of sliding.

[24] Source: http://www.el-cerrito.org/home/images/streetsimage1313.jpg, 19 Aug. 2010

Scientific Background

Skid resistance first increases, as the roadway is worn away by traffic and rough aggregate surfaces become exposed, then decreases, as aggregates become more polished. Skid resistance is also typically higher in the fall and winter and lower in the spring and summer (Jayawickrama and Thomas, 1998)

The problem is aggravated further in the presence of water, due to the phenomenon of hydroplaning (SKIDSAFE, 2009)

Treatment of frost, ice and snow has involved spreading mineral grit on the affected areas, but grit has been a factor in a number of crashes. The use of Calcium Magnesium Acetate (CMA) has led to significant reductions in the number of crashes and road closures attributed to ice (Jamieson, 2006).

Implementation

Additional costs for anti slip materials for road surfaces are a barrier.

The maintenance of anti slip road surfaces has to be guaranteed.

Expected Impact(s)

This measure will have an impact on safety.

It will support riders with the riding task in case of bad weather.

Within the 2BESAFE project motorcyclist stated in Focus Group Interviews that they consider slippery roads resp. road markings as very dangerous. The results of the online questionnaire showed that 60% of the respondents consider “weather” as a downside of riding; this assessment supports the FGIS statements. The results show that riders have a need for anti slip material on road surfaces.

The positive feedback of riders will show if the measure is working well, also a decreasing number of injuries/ fatalities because of a sliding bike will show the success of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure because it contributes to creating a safer road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Many countries apply minimum standards for skid resistance to either new road or both new and existing roads. Whereas the total level of skid resistance is a critical issue, as riders might use higher skid resistance to increase driving speed instead of increasing their safety margin, consistency and predictability of road surface friction is urgently needed. Even small areas of low friction may strongly raise the risk for PTW riders, in particular if the phenomenon cannot be perceived.

Road Surface Testing

Expected Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★☆
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★★★★☆

The roughness of the road is of major importance in terms of both road safety and driving comfort. Besides, the macrotexture of the pavement is essential for draining behaviour and skid resistance under wet conditions. Therefore, it is very useful to test the road surface and detect safety impairments.

Example:

The RoadSTAR is a test truck which allows measuring the most important surface properties and road geometry parameters under normal traffic conditions at measuring speeds between 40 km/h and 120 km/h (standard speed 60km/h). All measured values are tagged with differentially corrected GPS coordinates.

Above the rear axle, there is a water tank with a capacity of 6000 litres. The vehicle includes measuring devices for skid resistance, transverse evenness, longitudinal profile, texture and temperature, as well as dGPS coordinates, a digital video system and an inertial measuring unit for the determination of the vehicle's spatial position.

The RoadSTAR road surface tester was developed by the Stuttgart Research Institute of Automotive Engineering and Vehicle Engines in close cooperation with Austrian Institute of Technology experts.

http://www.ait.ac.at/research-services/research-services-mobility/road-surface-and-road-area-measurement-modelling-and-optimisation/eng-strassenzustandserfassung/?L=1

In its discussion paper, the European Union Road Federation, the Brussels Programme Centre of the International Road Federation in particular calls for increased levels of maintenance of European road infrastructure to ensure that accidents are not caused by road defects which could have easily and cheaply been fixed.

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.10

Also, in the paper from Monash University, it is detailed a new technology linked to monitor road surface defects and linked to Intelligent Speed Adaptation (ISA) systems to reduce speed accordingly.

http://monash.edu.au/muarc/reports/muarc260.pdf

Beneficiaries:

A regular inspection of the road surface is valuable for all road users but especially for motorcyclists because they depend on a predictable roughness. Regular inspections show the road maintenance departments where they have to take action.

Figure 27: RoadSTAR[25]

Clear definition of the problem

The interaction of the PTW-wheels and the road surface is crucial for a safe ride with the motorcycle. Inappropriate surface properties (poor skid resistance, cracks, ruts, unevenness, etc.), especially a critical combination, can be crash causal.

Size of the problem

Different projects and studies show specific PTW-accident influences of poor road surface quality in 3 to 10% of the accidents. In many cases it is not the main contributing factor, but some black spots analyses show the high risk of sudden changes in the surface quality as highly risky.

[25] Source: http://www.arsenal.ac.at/roadstar/products_mob_roadstar_was_en.html 17 Aug. 2009

Scientific Background

Lots of projects and case studies show the potential risk of poor road surface quality.

Almost all past studies look at influences of single parameters on PTW crash risk, which should be critically interpreted

2-BE-SAFE in-depth accident analyses (microscopic view) uses an approach of combined data correlations.

The important fact is an overlay of surface and trace parameters to verify inter-dependencies

Implementation

In principle, the implementation is rather easy. A couple of institutes have developed technical solution, hence, the equipment and can be acquired on the market, quite likely together with appropriate training on application. However, measuring campaigns are quite costly, which may be the bottleneck to implementation.

Expected Impact(s)

Testing and optimizing road surface characteristics will increase PTW safety. At black spots or risky road sections those measures are more effective.

Respective research within Activity 1.2 of 2BESAFE has found that especially the sudden changes and disharmonic parameters cause the highest risk. A continuous level of an appropriate quality is the key aspect regarding that measure to ensure safe roads for PTW-riding.

Risk compensation is often discussed within the context of proper road surface quality. Again it must be stated clearly, that a continuous level of surface quality is relevant – that means not to have e.g. the best quality of skid resistance, like on race tracks. More focus must be laid on the often underestimated influence of unevenness on motorcycle crashes.

Acceptance

The problem of acceptance is limited to a very small number of experts on the field, who are likely to recognise potential benefits. Concerns might be raised by road authorities bearing the expenses of implementation.

Sustainability

Road surface testing is a measure of creating sustainability, however, it has to be recognised that the results have limited validity over time and testing has to be repeated periodically.

Transferability

Road surface e testing is transferable to any place, where minimum requirements for friction are standardised. It may be even applied where no standards are in place but infrastructure providers consider surface friction an important issue. Application might be encumbered by considerable costs.

Costs and benefits

Pavement management systems prove the effectiveness of well planned road maintenance. The benefits are difficult to count monetary.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Wherever standards on road surface friction are in place, surveillance should receive high priority. Even if there are no standards applied, high and consistent skid resistance is highly beneficial to PTW safety.

Improvement of the Transversal Slope (Crossfall) in Curves

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★★★☆
Total impact	★★★★★	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★☆☆☆☆	Sustainability	★☆☆☆☆

Transversal slope affects the PTW rider's risk in curves. Negative crossfall is difficult to detect for a rider but strongly reduces contact pressure between tire and road surface. In particular, this has a significant impact under low friction conditions (wet road). Hence, it is useful to increase the transversal slope and to eliminate leaps within curves, which also temporarily may reduce contact pressure.

Example:

The measure originates from the national motorcycle guideline "Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken" published by FGSV. This measure aims for decreasing the number of accidents in curves.

FGSV (2007). Merkblatt zur Verbesserung der Verkehrssicherheit auf Motorradstrecken, p.22

Beneficiaries:

The measure is useful for all road users, but especially beneficial for PTW riders. By improving the transversal slope in curves, the number of PTW accidents should be reduced.

Clear definition of the problem

The driving dynamics and physics of PTWs in curves are crucial for safe riding. Side forces and the tire-road interaction are strongly influenced by the appropriate crossfall in curves. Especially poor skid resistance in combination with negative crossfall are risky and sometimes crash causal.

Size of the problem

A Vehicle-Infrastructure-Interaction Simulation verifies significant correlations of negative crossfall and a higher risk for PTW manoeuvres in bends.

Scientific Background

Vehicle dynamic and driving physics studies show the influence of crossfall on PTW collisions in curves. Thus, road design guidelines suggest transversal slopes based on driving dynamics.

Expected impact

Although the level of increased road safety resulting from verified data is unknown, this measure will definitely have an impact on road safety. There might also be negative effects due to risk compensation (higher speed in curves). The overall impact could be measured by crash analyses as well as by comparing accident statistics before and after the reconstruction.

Implementation

Resulting from limited budgets of road authorities, the main barrier concerning the implementation of this measure are the costs. Furthermore, a road safety audit would even help to skip that measure.

Acceptance

This problem is already well known, but too expensive. Sometimes the improvement of the transversal slope in curves is sometimes done to improve black spots.

Sustainability

It is not believed that there is a risk of fading effects.

Transferability

This measure can be applied worldwide as physical laws are similar for all areas and road types. But due to the relation between side forces and speed, it can be stated that improving the transversal slope in curves is not useful on low-speed sections.

Costs and benefits

Although there is no exact number known, it can be estimated that this measure is just cost-effective at black spots, where the influence of the crossfall on accidents was proven.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Expert statements clearly show that this measure is effective with hardly any collateral effects. A good overall rating is encumbered by a lack of scientific evidence and high costs.

Improvement of Pavement Friction on New Asphalt Surfaces

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★☆☆☆	Sustainability	★☆☆☆☆

In general, new asphalt surfaces enhance safety by improving the steerability of PTWs. Friction mainly originates from the contact between the rubber of the tires and the stones of the asphalt. The binder (bitumen) does not offer good friction. Hence, new asphalt surfaces need to be used for a while before they develop their full performance in terms of friction. Vehicles passing over remove the binder film covering the stones as a result of the manufacturing process. Because of the use of studded tires, low friction of newly built asphalt surfaces is a problem in Finland only before the first winter season (on patches and on completely new pavements). I.e. cars using studded tires during the winter will quickly remove the asphalt film covering the stones.

Example:

In Finland, road friction requirements for new asphalt surfaces are defined by the Finnish Asphalt Specification 2008 (Asfalttinormit 2008). It is published by PANK RY, 2008 (in Finnish only):

http://www.pank.fi/index.php?&id=324&m=71&s=195

Beneficiaries:

PTW riders benefit from this measure as it improves the steerability of their vehicles. The guideline addresses all vehicle classes and is targeted on the number of conflicts/accidents, especially on PTW single accidents. The goal of the guideline is to avoid PTW single accidents due to slippery pavement.

Clear definition of the problem

Low friction, especially on new asphalt surfaces, can lead to a loss of traction for PTWs due to the lower contact surface with the ground compared to four-wheeled vehicles, leading to a crash. The problem is normally considered to be self-solving by traffic operations on a new road. However, for roads with low traffic volumes, the state of low friction might remain for a long time.

Size of the problem

According to the results of MAIDS (2009), roadway maintenance defect (including inappropriate repairs) is a contributing factor or precipitating factor in 3,6% of the accident cases surveyed.

Expected impact

The measure has the potential to reduce accidents caused by low skid resistance, involving motorcycles and other vehicles.

Efficiency of the measure can be measured by comparing the rate of accidents where low friction was a contributing factor before and after its implementation.

Implementation

Barriers to the implementation of the measure include potential costs linked to the use of better asphalt mixes, lack of awareness of local authorities, and lack of training of contractors in using the appropriate techniques and materials.

Areas where high-friction pavement should be used in priority (e.g. curves, intersections where braking is expected to occur) need to be identified.

Local and national authorities in charge of roadway design and maintenance need to be aware of the issue, and of the options available to provide better grip.

Awareness can be raised through the dissemination of standards to the relevant authorities, and in the curriculum of traffic engineering courses. Some European countries have produced, in close cooperation with motorcyclists' organizations, handbooks for motorcycle safety, with detailed guidelines for all personnel working with road construction and maintenance. Similar initiatives by the European Union or in all member states would be useful. A compilation is available here (http://www.acem.eu/media/d_ACEMinfrastructurehandbookv2_74670.pdf)

Effective implementation can be used through the use of standards, with regular audits performed to check the continued compliance.

Risk compensation is expected to be low, due to the measure not being directly measurable by the user.

Acceptance

Acceptance is an issue mainly for infrastructure providers or road authorities that will have to cover the expenses for application of this measure.

Sustainability

Sustainability is rather limited by the purpose of this measure.

Transferability

The measure can only be applied where road surface material is used, which has low friction shortly after construction. Application may be encumbered by high costs.

Costs and benefits

No data available

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

The measure should be given particular attention, where low friction of new asphalt surfaces is a problem. It has to be recognised that positive effects are limited to a relatively short period.

Reduction of Roadway Debris from the Roadway and Roadside

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★★★☆☆

Roadway debris poses a greater problem for motorcycles than for larger vehicles. Debris can deflect a PTW's wheel when it is struck, causing the rider to lose control of the vehicle. Debris such as sand, cinders, gravel and substances spilled from trucks can cause a motorcyclist to lose traction and control. There are certain locations where debris is a particular problem for motorcycles, such as at horizontal curves or locations with limited manoeuvring space.

Example:

In the "Guide for Addressing Collisions Involving Motorcycles" published by TRB, it is suggested that highway maintenance personnel should look for debris as part of routine inspections. In addition, law enforcement and other public agency personnel that travel the roads frequently should be alerted to the problem, and provided instructions on how to deal with or report it. At first, high-crash locations and routes with high motorcycle should be targeted.

TRB (2008). Volume 22: A Guide for Addressing Collisions Involving Motorcycles, p.V-26

Beneficiaries:

This measure is especially beneficial for PTW riders, as it reduces the risk of losing control of the vehicle due to deflection caused by debris.

Figure 28: Debris on the roadway[26]

Clear definition of the problem

Roadway debris and diesel and oil spills can lead to loss of control for motorcyclists, from which it is often impossible to recover, leading to falls and crashes.

Size of the problem

Gravel, sand, loose bitumen, cracked sealer from previous repairs, and oil and diesel spills are dangers acknowledged by motorcyclists.

According to the results of MAIDS (2009), temporary obstruction of the roadway (including gravel, sand, and diesel and oil spills) is a contributing factor or precipitating factor in 3,8% of the accident cases surveyed.

[26] Source: http://www.1200bandit.de/b3schrott_verschmutzte_Strasse.jpg, 08 Sep. 2010

Expected impact

The measure has the potential to reduce accidents caused by foreign material on the road, involving motorcycles and other vehicles.

The efficiency of the measure can be measured by the speed with which foreign material is detected and cleared off the road.

Implementation

Standardized report forms, such as the Pan-European Hazard Report Form to allow all road users to report debris and other spillage to the appropriate authorities. A fast-track system of reporting fuel spillages to responsible authorities through a 24/7 call system, or another system allowing for fast reporting and response.

Road debris and spillages should be detected and removed through regular road inspection routines. Sweeping of roads should be part of regular maintenance routines, particularly in locations where sand or grit are used during the winter months to improve traction.

If for some reason the foreign objects cannot be cleared immediately upon being reported, appropriate signage should warn motorcyclists about the location and nature of the danger.

Construction of diesel tanks in lorries and cars should be redesigned to make them impossible to overfill, warning the driver if the tank-cap is not properly secured. Awareness campaigns should be conducted with professional drivers and motorists, warning of the danger posed to motorcyclists by overfilling the tank (diesel tends to be stored at low temperatures and expands in the vehicle's tank as it reaches ambient temperature, causing the tank to overflow and spill its content on the road. Diesel does not naturally evaporate, causing a skidding hazard to all vehicles, and especially two-wheelers, even after days or weeks).

Awareness can be raised through the dissemination of documentation to the relevant authorities. Some European countries have produced, in close cooperation with motorcyclists' organizations, handbooks for motorcycle safety, with detailed guidelines for all personnel working with road construction and maintenance. Similar initiatives by the European Union or in all member states would be useful. A compilation is available here

http://www.acem.eu/media/d_ACEMinfrastructurehandbookv2_74670.pdf

Risk compensation is expected to be low, due to the inherently occasional and unpredictable occurrence of the problem in the first place.

Acceptance

Acceptance is an issue mainly for infrastructure providers or road authorities that will have to cover the expenses for application of this measure.

Sustainability

The measure will only be sustainable if applied regularly.

Transferability

The example above can be duplicated in other countries, or at the European Union level. Specific guidelines for handling salt and grit used in winter conditions might be needed in areas where these are used.

Costs and benefits

No relevant literature could be found.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Roadway debris is an issue in terms of PTW safety. Removal operation applied at a standardised quality level are likely to improve safety, not only for PTW riders and may be particularly important where gravel is used to improve friction on snow surfaces.

Maintenance of Roadway Surfaces in Work Zones

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	☆☆☆☆☆	Sustainability	★★☆☆☆

There is a continual process of upgrading the roadway systems in order to meet the increasing demand for traffic capacity and safety. During construction, it is important that the roadway surface allocated for traffic use is adequate for all users, including motorcyclists. Work zones often require that lanes be shifted or new surfaces be erected on an alternate route so that construction can be undertaken on the original road. During this process, it is essential that the travelled surface be kept free of obstructions and obstacles such as construction debris, extreme or unexpected surface undulations, temporary surface covers or markings that offer little or no traction for motorcycles, and significant surface elevation drops and rises generally occurring at joints between permanent roadway and temporary surfaces during the construction period.

Example:

The Virginia Department of Transportation (VDOT) formed a Motorcycle Safety Action Team to improve the conditions on Virginia highways for motorcyclists and to improve motorcyclists' understanding of VDOT and the local governments as operators of highways. One of the team's main tasks is to "review the work zones through the motorists' eyes".

http://www.virginiadot.org/programs/resources/3motorcycle.pdf

Beneficiaries:

As this measure facilitates the safe passage of motorcycles in work zones, it reduces the number of PTW accidents due to poor friction.

Clear definition of the problem

Work zones often require that lanes be shifted or new surfaces be erected on an alternate route so that construction can be undertaken on the original road, hence significant surface elevation drops and rises generally occurring at joints between permanent roadway and temporary surfaces during the construction period. In addition, obstructions and obstacles such as construction debris, extreme or unexpected surface undulations, temporary surface covers or markings that offer little or no traction for motorcycles, might exist that put in risk PTWs.

Size of the problem

Rider speed should be reduced and attention should increase in such zones, to avoid accidents. Keeping the roadway surface at a good condition does not require the aforementioned actions.

Scientific Background

There is no scientific evidence to support measure implementation.

This measure can work as there are PTW accidents caused by adverse pavement conditions.

The measure does target the identified problem.

Implementation

The cost of maintaining a good road surface against the gain of accidents could be more.

There are no critical issues that need to be considered or things to avoid when implementing the measure.

Awareness can be raised (although it is not required) from local media and motorcycling clubs.

Expected Impact(s)

This measure might increase PTW road safety in such conditions.

This measure can reduce PTW accidents in workzones.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

A before and after study of number of accidents and accident severity will indicate the measure's success.

Risk compensation can be a problem as PTW riders could ride more aggressively (e.g. at higher speeds) or be less focused to the driving task.

Acceptance

Acceptance is an issue mainly for infrastructure providers or road authorities that will have to cover the expenses for application of this measure.

Sustainability

Fading effects could involve PTW riders riding more aggressively or at higher speeds due to risk compensation.

Transferability

The measure can be implemented anywhere and no conditions are required for its implementation.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

This measure should not be given that high priority, as it is expected (due to risk perception) that PTWs in most cases ride in a more careful way in work zones if they are informed in advance (upstream of the work zones) with appropriate signs of their existence.

Further Issues concerning Friction

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★☆	Implementation	★★★☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★☆☆☆

Especially road markings as well as worn out access/inspection covers tend to be more slippery than the rest of the road surface, especially when wet. Because of the diminished friction, this can create problems for motorcyclists when braking and turning.

Example:

Norwegian Public Roads Administration's handbook "MC Safety" lists two possibilities to avoid friction loss due to road markings: On the one hand, road marking material with favorable frictional properties should be selected. In particular in areas where motorcyclists must brake or turn, frictional properties should be preferred to functional ones. On the other hand, pavement markings, which are closer than 10 meters from a stop or yield line, should be avoided. This will give the motorcyclist an adequate area for braking and turning at intersections.

Norwegian Public Roads Administration (2004). MC Safety, p.19

Besides, today's inspection covers, which are designed with raised metal studs to increase grip, can be replaced by innovative ones to increase friction as the common access covers wear away over time and are prone to become smooth and slippery by decades of traffic. As an example, the product of the manufacturer Saint Gobain Pipelines called "Griptop" has – instead of surface metal studs – a 2mm deep tray in which diamond bauxite is anchored in a special adhesive.

http://www.griptop.co.uk/

FEMA's European Agenda for Motorcycle Safety lists these issues concerning friction, too. Especially cast metal sewage covers, rain grooves, slippery road markings and tram rails can be dangerous for motorcyclists.

FEMA (2007). A European Agenda for Motorcycle Safety, p.46

Furthermore, TRB addresses the problem of poor friction, too. Thereby, surface treatments, which compromise a PTW's traction, are identified as follows:

- Bituminous rubberized asphalt sealer (used for crack repair)
- Plasticized adhesive pavement-marking tape
- Manhole covers
- Raised pavement markers

In order to increase the friction of this variety of treatments, routine testing of marking materials should consider including a test for the traction needed by motorcycles and reflect the compatibility of these applied materials to motorcycles in various temperatures and wet and dry conditions.

TRB (2008). Volume 22: A Guide for Addressing Collisions Involving Motorcycles, p.V-12

Beneficiaries:

This measure is addressed to all motorcyclists and aims to avoid PTW single accidents due to slippery road markings and other obstacles within the road surface.

Figure 29: Safer inspection cover[27]

Clear definition of the problem

Skid resistance, rubber and road friction, texture, etc. and their functions and correlation of crash causes must be investigated. Especially for PTW safety a detailed knowledge of issues concerning friction have to be studied in-depth. Tire-road interaction at driving maneuvers in bends, braking on different surface characteristics, driving dynamics, toothing effects, etc. must be known well to increase motorcycle safety.

[27] Source: http://www.griptop.co.uk/, 03 Aug. 2010

Size of the problem

An influence of 1 to 5% is estimated.

Scientific Background

Lots of scientific work and projects regarding the topic friction vs. road safety exist. Most of the research institutes in Europe, who are working on those issues, are in the FEHRL group (Forum of European Highway Research Laboratories).

Implementation

- Knowledge exchange and transfer is necessary. Training of road authorities/operators personnel is essential to provide practical efforts on the road.
- Raising awareness on the influencing factor of poor skid resistance in some cases of accidents is needed

Expected Impact(s)

See chapter “size of the problem”; exact data are not published. WP1, Activity 1.2 of 2BESAFE did some in-depth analyses regarding influence of friction/skid resistance on PTW accident risk.

Acceptance

Quite likely, PTW riders and other road users will welcome this measure. Acceptance is an issue mainly for infrastructure providers or road authorities that will have to cover the expenses for application of this measure or will have to change procedures maintained for a long time.

Sustainability

Changing standards and procedures of surface treatment, road construction and repair is sustainable by nature.

Transferability

This measure is of a rather general nature and includes a lot of potential improvements, that can be applied anywhere they are not already in place.

Costs and benefits

This measure includes various different treatments, information on macroeconomic impact could not be found.

Riders' perspective

★★★★★

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priority

Since this measure includes various different treatments, priority should be given according to the actual problem to be solved. However, in general consistent friction is an issue in terms of PTW safety and should not be constrained by installations within or upon the road surface or poor maintenance.

7. Vehicles and Safety Devices

7.1. Organizational Measures

Type Approval

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★☆☆
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★☆☆

Type approval is a process, which aims at ensuring all vehicles of a certain group or category to fulfill common criteria. There may be various reasons to define mandatory provisions for vehicles, however, the underlying principle is always the same:

- The issue addressed in a law is considered to be important for safety, security, quality of live, for the environment or another important reason.
- It is unlikely that the specification required will not be fulfilled by leaving it to competition on the market.

In other words, mandatory regulations are to establish equal conditions on the market for all competitors.

Examples:

The Council Directive 92/61/EEC, later repealed by Directive 2002/24/EC, addressed 47 different properties of a vehicle. 25 of these particular requirements are laid down in detail in other Directives.

The Directive covers:

1. Make
2. Type/variant/version
3. Name and address of vehicle manufacturer
4. Name and address of vehicle manufacturer's authorized representative
5. Category of vehicle
6. Number of wheels and their position in case of three-wheel vehicle
7. Outline drawing of frame
8. Name and address of engine manufacturer (if different from vehicle manufacturer)
9. Make and description of engine
10. Type of engine ignition
11. Engine operating cycle
12. Type of engine cooling
13. Type of engine lubrication
14. Number and configuration of cylinders or stators (in the case of rotary-piston engine) in the engine
15. Bore, stroke, cylinder capacity or volume of combustion chambers (in the case of rotary-piston engine) in the engine
16. Full diagram of the engines induction system
17. Engine compression ratio

18. Maximum torque and maximum net power of engine, whether this is: of the spark-ignition or compression-ignition type; or electric
19. Anti-tampering measures for mopeds and motorcycles
20. Fuel tank
21. Traction battery/ies
22. Carburettor or other engine fuel supply system (type and make)
23. Electric system (nominal voltage)
24. Generator (type and maximum output)
25. Maximum design speed of the vehicle
26. Masses and dimension
27. Coupling devices and their attachment
28. Anti-air pollution measures
29. Tires
30. Transmission
31. Braking system
32. Installation of lighting and light-signalling devices on the vehicle
33. Lighting and light-signalling devices on the vehicle the mandatory or optional presence of which is laid down in the installation requirements under heading No 32
34. Audible warning device
35. Position for the mounting of rear registration plate
36. Electromagnetic compatibility
37. Sound level and exhaust system
38. Rear-view mirror(s)
39. External projections
40. Stand (except in case of vehicles having three or more wheels)
41. Devices to prevent unauthorized use of the vehicle
42. Windows; windscreen wipers; windscreen washers; devices for de-icing and de-misting for three-wheel mopeds, motor tricycles and quadricycles with bodywork
43. Passenger hand-hold for two-wheel vehicles
44. Anchorage points for safety belts and safety belts for three-wheel mopeds, motor tricycles and quadricycles with bodywork
45. Speedometer
46. Identification of controls, tell-tales and indicators
47. Statutory inscriptions (content, location and method of affixing)

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0061:en:NOT

As of November 2003, the European Community Directive 2002/24/EC repeals the Directive 92/61/EEC. This Directive applies to two and three-wheel motor vehicles, double-wheeled or other types, intended for road use, with a maximum design speed exceeding 7 km/h, as well as to the components and separate technical units of such vehicles. The directive also applies to quadricycles. Amongst others, the type approval process described in the Directive includes an assessment of the production and quality control procedures of the manufacturer and a follow-up to ensure that the original conditions for granting type approval are maintained during the production life of the vehicle.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0024:en:NOT

As mentioned above, type-approval requirements for new vehicles of the L category are currently set out in Directive 2002/24/EC1 of the European Parliament and of the Council (the 'Framework Directive'). In addition, a series of Directives referred to in the Framework Directive contain detailed technical requirements relating to L-category vehicles. But the Commission has identified a number of key concerns associated with the current provisions for the type approval of L-category vehicles:

- the complexity of the legal framework
- the level of emissions and its increasing share in total road transport emissions, which are decreasing overall
- safety aspects
- lack of a legal framework for new technologies

Hence, a proposal for a "Regulation of the European Parliament and of the Council on the approval and market surveillance of two- or three-wheel vehicles and quadricycles" was published in October 2010. The objectives of the initiative are to simplify the current legal framework, to contribute to a lower, more proportionate share of overall road transport emissions, and to increase vehicle safety for new vehicles entering the market.

The specific simplification objective is to develop a less complex regulatory approach that ensures greater efficiency, less time loss and less burdensome adaptation to technical progress and which eliminates duplication of international standards, so that stakeholders are not confronted with several sets of different requirements addressing the same concern.

The specific objective for emissions is to keep the share of L-category vehicle emissions in total road transport emissions at least constant compared to current levels, or preferably to reduce them in proportion to actual use/total mileage compared to other road vehicle categories. Evaporative emissions may also need to be addressed.

The specific safety objectives are to help achieve the same high reductions in road accident fatalities and casualties as for other means of road transport, with the falling trend in passenger car fatalities since 2000 as the benchmark, to maximize accident mitigation to prevent serious and minor injuries as much as possible, and to help close the gap between actual road accident fatalities and casualties and the medium- to long-term road safety targets.

Finally, a number of technology developments should be reflected in legal requirements at EU level in order to allow the industry to type-approve a product only once and then to place not only certified products on the EU internal market but also in countries that opt to apply UNECE regulations.

http://ec.europa.eu/enterprise/sectors/automotive/files/com-2010-542_en.pdf

In Australia, a national standard for vehicle safety, anti-theft and emissions exists. The Third Edition Australian Design Rules (ADRs) apply to vehicles newly manufactured in Australia or imported as new or second hand vehicles, and supplied to the Australian market. In total, 84 standards are defined, of which are not all applicable for two and three wheeled vehicles.

For vehicles manufactured up until July 1989, the application of the ADRs is the responsibility of the state and territory governments. Vehicle users should consult with their state or territory transport authority for the Second and Third Edition ADRs that apply to these vehicles. For vehicles manufactured after July 1989, the application of the ADRs is the responsibility of the Australian Government under the Motor Vehicle Standards Act 1989. Vehicle users should consult with this department for the Second and Third Edition ADRs that apply to these vehicles.

http://www.infrastructure.gov.au/roads/motor/design/adr_online.aspx

Beneficiaries:

It is assumed that the users of a vehicle category, which is object of a legal assessment of technical quality and compliance to legal and technical provisions, are the primary beneficiaries in most cases. However, other road users and citizens may also benefit, e.g. in case of exhaust gas regulation or provisions on noise level. Further, the risk exerted by a vehicle to other road users may be reduced. Even if such a procedure only protects the rider (e.g. if airbag installation would be mandated), citizens benefit on the macroeconomic level by reducing their expenditure for crash costs (i.e. vehicle insurance, social insurance, health insurance, taxes, etc).

Clear definition of the problem

Type-approval offers a clear legal framework laying out the technical requirements for the construction, safety and environmental performance of vehicles sold on the market, manufactured locally or imported. Compliance with these rules provides customers with products they can rely on, and keeps non-compliant vehicles out of the market.

Size of the problem

All customers on the market can benefit from compliance with type-approval regulations, with safety and environmental standards. In countries where transnational type-approval exists (e.g. the European Union) manufacturers can reduce costs by having vehicles approved once for several countries, thus reducing retail prices for the customers.

Expected impact

The measure is already in place. More details on the rationale for action in type-approval can be found in the European Commission's impact assessment of the regulation on the approval and market surveillance of two- and three-wheel vehicles and quadricycles:

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2010:1152:FIN:EN:PDF

In particular, the introduction of market surveillance in the regulation aims at reinforcing the tools available to check that imported vehicles and parts comply with the regulation, and act quickly if they do not.

Implementation

Implementation of a sound type approval procedure is not easy since it requires a lot of highly qualified staff and large investment to testing equipment. Legal and administrative procedures have to be set up that are not likely to be corrupted.

Acceptance

Mainly there are two groups concerned. Car manufacturers worldwide are well familiar with type approval. Procedures have been widely harmonised. Hence, their willingness is only likely to accept a type approval procedure would only suffer from requirements that are going beyond what is already tested, i.e. if additional expensive tests have to carried out. The main issue is the willingness of public administration and politicians in a country to implement a type approval procedure, to find a solution for covering implementation costs and maybe, to deal with resistance with local car makers, which are not present on the global market and hence, would have to cover the additional costs of type approval testing.

Sustainability

A sound type approval procedure is highly sustainable if it is regularly updated according to technical development.

Transferability

See statements on implementation.

Costs and benefits

According to Elvik & Vaa (2004, pp 806ff) the overall impact of implementing type approval has reduced road traffic death by 30 to 40% since 1980. If the value for a human life is considered 1 Mio. USD, the benefit-cost ratio is estimated between 1.89 and 7.16. Hence, type approval is highly cost-effective. This value is provided for cars, there was no information available on PTWs.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

Considering huge safety improvements, at least to a certain extent achieved by implementing type approval, the low ratings of the experts are surprising. It has to be considered that experts consulted within the survey are Europeans or Australians and hence, consider type approval as a matter of course, which is in place in their countries for decades.

Definition of a Moped

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★☆☆

Defining technical parameters of a moped is not a safety measure. Nevertheless the safety impact may derive from the typical context of using a moped. Currently, "moped" tends to be terminus technicus in some countries. But the term could also be used for the kind of powered two wheel vehicle that can be used by everyone without a license, without having any restriction for use of protective equipment.

Typically, such a category of vehicles in many countries was defined with an engine displacement of less than 50 cc limited to a speed of about 40 km/h. Various additional technical provision may be taken in order to limit performance and inhibit tuning. The 3rd Driving License Directive mandates European countries to implement a licensing system for mopeds. Helmet use is already mandated in all European countries. For these reasons, a vehicle category following the definition provided above, would vanish from European roads.

Hence, the definition of a moped might be altered towards a category, which is close to the technical parameters mentioned above, which significantly differs from other categories of PTWs in terms of minimum age and required educational and licensing standards.

Example:

Definition according to European Directive 2002/24/EC of the European Parliament and of the Council of 18 March 2002 relating to the type-approval of two or three-wheel motor vehicles and repealing Council Directive 92/61/EEC:

- two-wheel vehicles (category L1e) or three-wheel vehicles (category L2e) with a maximum design speed of not more than 45 km/h and characterized by:
  - in the case of the two-wheel type, an engine whose:
  - cylinder capacity does not exceed 50 cm^3 in the case of the internal combustion type, or
  - maximum continuous rated power is no more than 4 kW in the case of an electric motor;
  - in the case of the three-wheel type, an engine whose:
  - cylinder capacity does not exceed 50 cm^3 if of the spark (positive) ignition type, or
    - maximum net power output does not exceed 4 kW in the case of other internal combustion engines, or
    - maximum continuous rated power does not exceed 4 kW in the case of an electric motor;

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0024:en:NOT

The previous regulation, Directive 92/61/EEC already included the most important conditions (45 km/h, 50 cc), Member States had equal or similar regulations before; additional requirements had existed in some countries.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0061:en:NOT

Beneficiaries:

The definition of a vehicle category accessible at little effort concerning education, licensing and use of protective equipment follows the idea of providing access to means of individual motorized mobility at a limited level of risk, addressing in particular very young road users or groups of people, which, from any reason would face insuperable barriers in either attaining a regular driving license or a vehicle.

Hence, definition of a moped determines the level of risk accepted for such a category of vehicle and the respective group of road users.

Figure 30: Moped[28]

Clear definition of the problem

“Mopeds”, though not strictly defined yet, usually include vehicles that can be ridden by people who do not own a riding license; this feature strictly relates to the problem of the definition to a range of accident scenarios involving young or however unlicensed riders.

Size of the problem

To some extent, this problem is related to the accidents involving unlicensed and therefore inexperienced or poorly trained riders.

Scientific Background

This measure basically relates to reaching an agreement about the definition of Mopeds, so no scientific underpinning may be expected here.

This measure will help clarifying the results and data being brought about by specific researches and analyses, by disambiguating the categories being used for analysis (i.e.: by removing ambiguities when referring to “mopeds”).

The aim of this definition is to simplify the analytical tools for addressing safety problems, not to solve problems itself.

Expected impact

This measure addresses the whole PTW domain.

The impact of such a measure will be hardly perceived on a quantitative basis, though it should be appreciated to the extent to which it will clarify any reference to Mopeds.

Consistency of the term’s uses in future scientific publications, reports, norms.

Disagreement may arise among players; particularly, manufacturers may dislike a definition that suggests that mopeds are a low-end product in the whole PTW range.

Implementation

A broad agreement should be found among the players of the PTW domain, namely manufacturers, users, researchers and public authorities.

Unambiguous references should be provided in order to let references to “Mopeds” be properly made.

A definition cannot be imposed or enforced, but a consistent use of it should be encouraged and applied throughout the community of the PTW domain, by researches in first place.

[28] Source: http://www.mcvt.de/neckermanncondorrekord.html, 31 Jul. 2009

Examples of the consequences of an inconsistent or misleading use of the term “Moped” may be provided (e.g.: misinterpretation of accident research data or norms).

Acceptance

The negative effect of a confusing PTW classification may be explained to those opposing the measure. Acceptance has to assess in link with the administrative framework around the use of mopeds, i.e. age limit, mandatory training, testing, health testing and technical regulations.

Sustainability

The evolution of the PTW industry may make this definition obsolete, but periodic reviews may help keep it up to date. Sustainability, just like acceptance, has to be considered with respect to legal requirement for use of this category of vehicles. The definition is inevitable, if a "small" category of PTW (low administrative requirement and low power output) shall be made available.

Transferability

A "small" category of PTW can be defined anywhere, it may be useful adopting widely applied limits (50 cc engine displacement, 45 km/h maximum design speed)

Costs and benefits

Cost-benefit figures cannot be provided.

Riders' perspective

★★☆☆☆

The riders' associations support this measure in its capacity to provide researchers and decision-makers with a clear picture of vehicle categories across Europe, along with assorted figures on ownership, use and accident data, in order to properly assess safety needs per category of vehicle.

Priorities

A statement on priority cannot be provided. Such a definition is inevitable if a "small" category of vehicles is or shall be implemented, else it is futile.

Multi-Wheel Vehicles

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★☆☆☆☆	Acceptance	★★★☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★★☆

Although the group of PTWs is made up of mopeds and motorcycles, some multi-wheel vehicles should be included in it, too. Some of these special multi-wheel vehicles are designed with a stock suspension, which allows sloping positions known from biking. But due to their additional wheel(s), resulting in a larger contact area, these vehicles provide improved braking and stability over poor surfaces. This volume does not intend to address three- and four wheel vehicles (trikes, quadricycles. ATVs, etc); nevertheless, some vehicle are included here since the constructive principles intend to provide a similar feeling as riding a PTW.

Example:
Piaggio’s MP3 as well as Gilera’s Fuoco 500 are 3-wheeled scooters, which have two front wheels for steering, whereas the power is delivered from the single rear wheel.

http://www.mp3.piaggio.com/index_eng.html

Yamaha's Tesseract is a four-wheeled hybrid eco-motorcycle that is powered with a liquid-cooled V-twin engine and electric motor. So far, just a prototype has been shown, with a release not scheduled until after 2010.

http://green.autoblog.com/2007/10/06/tokyo-2007-preview-yamaha-on-two-wheels-tesseract-part-2-o/

Beneficiaries:

These multi-wheel vehicles offer a counter measure to PTW collisions involving loss of control, especially on poor surfaces and in wet or icy conditions.

Figure 31: Yamaha Tesseract[29]

Clear definition of the problem

Multi-wheel vehicles may offer some advantages in terms of driving stability and braking performance. To a certain extent, they are also an issue of life style or a solution to people who are afraid of riding on only two wheels. However, there is no actual problem to solve, if the use of PTWs is not considered a general problem.

Size of the problem

Three-wheeled scooters are a growing part of the transport mix. In 2010 in France, the Piaggio MP3 (all variants) was the best-selling PTW model on the market. However, no specific accident data is available as of yet.

Scientific Background

Tests performed by motorcycle magazines show that three-wheeled scooters can remain upright while skidding on loose gravel in curves. The two front wheels offer a larger contact surface with the road compared with a common PTW design, reducing braking distances under certain circumstances, and compared to certain motorcycle and scooters (Piaggio claims that the MP3's braking distance is 20% shorter than that of the best scooters on the market).

Expected impact

Considering that the majority of PTW accidents are caused by other vehicle driver error and not by loss of control or braking, the potential benefits of multi-wheel vehicles should not be overestimated.

The vehicle construction involved differs from that used on two-wheeled vehicles. The technologies involved increase both volume and weight. For instance, a Piaggio MP3 125cm3 weighs 199kg, compared to 110 to 160kg for a 125cm3 scooter from the same manufacturer. Therefore, three- or four-wheeled scooters or motorcycles cannot replace existing models, but could exist alongside them, catering to a different demand.

Implementation

The use of multi-wheel vehicles is driven entirely by consumer demand and the variety, quality and cost of products offered by manufacturers. They are more attractive in areas where license regulations allow their use as tricycles for B-license holders.

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[29] Source: http://media.motosport.ch//files/51759_2007100502_001yamaha_1200_kopie.jpg, 02 Aug. 2010

Acceptance

Multi-wheel vehicles have only been available on the market for a few years, with only one model (Piaggio MP3) offered by a single manufacturer. The system is patented, reducing opportunities for other manufacturers to offer similar vehicles. The Piaggio MP3 mainly caters to the market segment occupied by large scooters, for an urban use, typically for commuting trips. As such, existing variants and proposed future designs only cover one narrow market segment, and cannot be an option for all powered two-wheeler uses and users. Furthermore, the three-wheel design has several inherent flaws: it is heavier, less maneuverable in certain conditions, wider, and more expensive than scooters with comparable characteristics.

The handling of tricycles with two front wheels is fundamentally different from a motorcycle or scooter. The vehicle stands upright through electromechanical action on the suspension and not the gyroscopic effect, requiring different actions on the controls and a different training. As such, the sensations and feedback offered by a three-wheeled our four-wheeled scooter differ greatly from motorcycles.

In addition, three-wheeled designs have also been introduced by manufacturers to offer an alternative to the 125cm^3 PTW to B-license holders. Variants of the Piaggio MP3 offered in some countries are classified as tricycles, and accessible without an A-license. Compared to a 125cm3 scooter or motorcycle available in the same license category, the MP3 is more powerful and faster, can be more stable at low speed or when stopped, and offers a better carrying capacity. However, these perceived advantages are less desirable to A-license holders who have access to all motorcycle and scooter types.

Sustainability

If there are safety effects, they might be sustainable for this category of vehicles compared to two.-wheelers.

Transferability

Transferability is high and will occur naturally as manufacturers export their products to new areas, provided that the regulatory environment allows for the use of multi-wheel vehicles.

Costs and benefits

No information was found.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

Use of multi-wheel vehicles could be recommended or advertised, as soon as a safety effect is soundly evaluated.

Standard on measurement of maximum speed of PTWs

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★☆☆
Total impact	☆☆☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★☆☆☆☆

The maximum speed of the vehicle is expressed in kilometers per hour by the figure corresponding to the closest whole number to the arithmetical mean of the values for the speeds measured during the two consecutive tests, which must not diverge by more than 3 %. When this arithmetical mean lies exactly between two whole numbers, it is rounded up to the next highest number.

Example:

The measure is targeted by Annex III – Amendment to Directive 95/1/EEC Commission Directive 2006/27/EC of 3 March 2006 amending for the purposes of adapting to technical progress Council Directives 93/14/EEC on the braking of two- or three-wheel motor vehicles and 93/34/EEC of 5 April 1993 on statutory markings for two- or three-wheel motor vehicles.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006L0027:EN:NOT

Beneficiaries:

As far as safety effects are considered, riders and vehicles manufacturers benefit from reliability of technical descriptions of vehicles.

Clear definition of the problem

A standard for measurement of maximum speed is an issue of safety e.g. for mopeds, where a design speed is limited. Safety impact may also be expected where other features of the vehicle like brakes or tires have to fit a vehicle operating at a certain speed. It is also an issue of reliability, which shall ensure that the purchaser gets what she/he pays for.

Size of the problem

At least for mopeds, tampering is an issue and can only be effectively encountered if procedures for standardised measurement are available.

Expected impact

Improves reliability of technical descriptions; facilitates enforcement of tampering.

Implementation

Internationally applied best practice examples are available and can easily be implemented in an existing procedure for tape approval.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

A standard for measurement of maximum speed of vehicles is a necessary element of a type approval procedure.

Mounting the Rear Registration Plate

Expert Assessment			
Overall		★★☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★★☆
Total impact	☆☆☆☆☆	Implementation	★★★★★
Safety impact	☆☆☆☆☆	Acceptance	★★★☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★★★

This measure concerns the dimensions of rear registration plates and the place for mounting them. It shall ensure the visibility and readability of the registration plates. The dimensions of the plates vary by country and vehicle categories.

Examples:

The mounting of the rear registration plate is regulated by the directive „Space for mounting the rear registration plate of two or three-wheel motor vehicles - 93/94/EEC", which was implemented in 1993. The mounting for the rear registration plate of a motorcycle, motorcycle combination or tricycle must be located at the rear of the vehicle in such a manner that the plate can be positioned within the longitudinal planes passing through the outer extremities of the vehicle (Space for Motorcycles, tricycles up to a maximum power of 15 kW and quadricycles other than light quadricycles: Width: 280 mm; Height: 210 mm; Space for Mopeds and light quadricycles: Width: 100 mm; Height: 175 mm).

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0094:en:NOT

Within ETSC's Safety Recommendation "Vulnerable Riders", measures towards readability of PTW license plates are also addressed.

ETSC (2008). Vulnerable Riders, p.19

Beneficiaries:

Standardized mounting of the rear license plate is beneficial mainly for enforcement purposes.

Clear definition of the problem

Definition of requirements for license plates and enforcement procedures have to be mutually adopted.

Size of the problem, scientific Background

It is unknown to which extent poor readability of license plate of PTWs hinders effective enforcement.

Expected impact

In case license plates have adequate dimensions and are properly mounted (as a result of respective legal obligations and technical standards) a 100% detection rate of vehicles by enforcement personnel or equipment shall be achieved.

Implementation

Implementation requires a technical standard on mounting of license plates and the license plates themselves. The latter might require adoption of the production processes. Proper mounting has to be considered by vehicle manufacturers.

Acceptance

Acceptance is an issue for enforcement bodies, vehicles and license plate manufacturers. The issue was raised within 2BESAFE because riders in some places offended the rules in order to impede enforcement. This is not an issue of acceptance.

Transferability

Respective technical standards and legal obligations can be implemented anywhere.

Costs and benefits

Costs may be considered rather low, since efforts do not significantly vary by, e.g. size of the license plate and angle of mounting. Penalties are by definition not considered for macroeconomic assessment. It may be assumed that riders aware of the fact that they are not anonymous have stronger motive to avoid offences.

Riders' perspective

★★★★★

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

Expert ratings may be interpreted that they consider readable license plates and important issue but do not spot any necessity for changes to the current situation.

7.2. Brakes

Requirements for Braking

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★☆☆☆

In order to cope with the requirements of daily traffic, efficient braking is demanding both the rider and the vehicle.

Example:

Council Directive 93/14/EEC of 5 April 1993 on the braking of two or three-wheel motor vehicles (adopted by Directive 2006/27/EC) within the chapter 2.2.1 of the Annex defines as follows:

"Every two-wheel moped or two-wheel motorcycle shall be equipped with two service braking devices, with independent controls and transmissions. One of the devices should at least act on the front wheel and the other at least on the rear wheel."

Furthermore, this directive determines thresholds for minimum deceleration to be achieved by either front (depending on the category of vehicle 2.7 to 3.6 m/s²) or rear (2.7 to 3.6 m/s²) brake of both brakes together (4.4 to 5.8 m/s²).

The measure is regulated in Annex IV – Amendment to Directive 97/24/EEC. It is already internationally implemented (2006) and concerns the General characteristics (type, variant, version) of the vehicle description in six characters. The guideline has already been evaluated on public acceptance.

Both the requirements of having two independent brake handles and brake devices as well as the minimum required performance of the brakes have been under discussion of experts on the field, the reasons for discussion are:

- Humans are single-channel operators. That means that a motorcycle rider by nature is overcharged in operating two brakes.
- Modern vehicles perform much better than the thresholds given in the directive, hence, these thresholds could be adopted to be more challenging for new vehicles.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1993L0014:20060328:EN:PDF

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:066:0007:0015:EN:PDF

Beneficiaries:

This kind of legislation has two basic functions:

- These definitions and requirements shall ensure safe traffic participation of the addressed vehicle users.
- Such definitions shall also ensure that no manufacturer economically benefits from offering vehicles performing worse than the others. It is excluding safety issues from competition on the market.

From this point of view, rider benefit from appropriate technical performance of vehicles. Safety-oriented manufacturers benefit from fair conditions on the market.

Clear definition of the problem

Brakes are a key safety element of PTW. Competition on the market from time to time results in compromising safety for the benefit of lowering prices and improving sales. Such compromises can be expected to be rather unfavourable in terms of crash avoidance, usability and effectiveness of braking systems. Hence, a comprehensive set of requirements is needed, defining minimum standards of brake performance and respective test procedures.

Safety standards serve two purposes: On the one hand, they determine performance thresholds for vehicles to enter the market. On the other hand they serve as minimum requirements for vehicles within periodic inspection.

Size of the problem

No study could be found, which particularly addresses the impact of improved brake performance on PTW crashes. However, there are a number of studies mostly from the United States of America, which indicate a decrease of 40% of fatalities among motorists if stringent safety standards are implemented. Unfortunately these studies also show an increase of 7% of fatalities of other road users. The total impact is expected -30% fatalities. (Elvik et al, 2009, pp 737-742)

Scientific Background

Brake performance of PTW is limited by two factors: One the one hand, there's performance of the rider with the human as a one-channel controller (having to deal with two brake devices). Riders also know about consequences of blocking wheels and hence, do not use brake to their full technical potential (Vavryn & Winkelbauer, 1998). Design and layout of brake system should consider this issue. On the other hand, there are technical restrictions from both the vehicle (brake performance, tires) and the infrastructure (road surface conditions).

Expected impact

As indicated above, precise estimates about the impact of implementing comprehensive rules on brake standards could not be found.

Implementation

In general, implementation of technical standards needs to be balanced between the theoretical or practical optimum (e.g. the best-performing vehicles on the market), achievability by other vendors, scientifically proved safety requirements and financial aspects. Technical standards from other countries and markets should be considered. An adequate transitional period has to be foreseen.

Acceptance

In general, implementation of technical standards does not meet the immediate interest of purchasers. If implementation is opposed, in most cases it is either industry (most frequent argument: technical feasibility) or riders' associations (either opposing due to an expected increase of purchase costs or due to interference with the model of sovereignty of riders or purchasers).

Sustainability

The only potential barrier to full sustainability is technical development. Today's motorcycles generally perform much better in terms of braking than required by technical standards.

Transferability

Since the PTW market is a global one, technical standards are highly transferable.

Costs and benefits

According to Crandall et al (1986), implementation of comprehensive vehicle safety standards is highly efficient, however, these figures cannot be directly applied to brake safety standards of PTW.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it provides customers with reliable information about products offered for sale.

Priorities

In the EU, there is a comprehensive set of safety standards for type approval and periodic inspection. The legal framework for type approval is currently under revision. It may be expected that advanced braking systems are going to be mandatory equipment. Any potential improvement of safety standards should be implemented as soon as possible.

ABS and other Advanced Braking Systems

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★☆☆
Efficiency	★★★★★	Sustainability	★★★☆☆

Everyday experience tell a PTW rider: The closer an obstacle, the harder you have to brake. This message goes deep beneath the skin, but creates trouble as soon as an obstacle is too close to stop. In such situations, riders do not react intentionally. With any conscious process of decision making, they will apply what they have trained many times before and pull the brake levers as hard as they can. Unfortunately, this typically results in blocking one or both wheels and falling off the vehicle. This typical phenomenon may be called "the survival reflex". Such reactions can hardly be controlled; even very experienced race drivers fail if such a situation happens unexpectedly. The only feasible opportunity is to use an anti-lock braking system. Further, many PTW riders are well aware of the particular risk of blocking up the wheel and, hence, apply the brakes much too soft under emergency conditions.

Besides, humans are single-channel operators. That means that a motorcycle rider by nature is overcharged in fully controlling two brakes (front and rear). This results in poor performance of PTW riders. Research found that PTW riders use the front brake to about 40% of its capacity, even if they are asked to stop as fast as they can. At the same time they operate the rear brake far above the optimum. It can be concluded that PTW riders need assistance in proper brake force distribution, which can be done by the use of combined braking systems (CBS).

Examples:

In the European Commission's policy orientations up to 2020, the progressive installation of advanced braking systems is claimed to increase PTW's safety.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

The Austrian Road Safety Programme appreciates the advantages of ABS and wants to increase the market demand for anti-lock braking systems. Furthermore it supports the EU activities for mandatory ABS for all motorcycles.

http://www.bmvit.gv.at/en/service/publications/downloads/brochure_roadsafety2010.pdf

ETSC's report "Vulnerable Riders" recommends mandatory installation of ABS for heavy motorcycles and proposes to urgently explore the potential of other advanced braking systems.

ETSC (2008). Vulnerable Riders, pp.12-13

The Australian national road safety action plan (2009-2010) contains promoting to riders the safety advantages of ABS, linked braking systems and traction control in motorcycles, and encourage the motorcycle industry to increase the availability of motorcycles with these features as measures.

ATC (2008). National Road Safety Action Plan 2009 and 2010, p.48

In 2004, ACEM signed the European Road Safety Charter agreeing to progressively supply PTWs with advanced braking systems taking into account their distinctive characteristics and cost-effectiveness of the technical solutions. By 2010 the majority of street models will be available on the European market with advanced braking systems, at least as an option. In June 2008, ACEM member manufacturers decided to renew this commitment beyond 2010, extending its coverage to 75% of street models by 2015.

ACEM (2008). A Safety Plan for Action, p.16

Beneficiaries:

The German Insurance Association GDV has estimated ABS to be beneficial in 55% of PTW accidents in terms of reducing accident numbers and mitigating severity of consequences. In 2004, ACEM signed the European Road Safety Charter binding itself to offer at least 50% of PTW street models with advanced braking systems as an option by 2010. In June 2008, 35% of the European PTW offer was already available with an advanced braking system, which translated into 35% actual penetration in terms of PTW sales.

Figure 32: ABS

Clear definition of the problem

Losing control of the path of the vehicle is a real risk should the brakes lock, and the fear of this occurring means few riders use the maximum brake potential of their vehicle.

Scientific background

Recently, Rizzi, Fildes and Oxley (2010) examined the literature on the effectiveness of ABS for PTW rider safety and concluded that the fitment of ABS braking technology on vehicles appears to be an effective, and cost-effective, technology that would return substantial benefits in fewer crashes and mitigated injuries to these vulnerable road users. The benefits may be of greater importance for larger PTW able to use high speed roads in rural areas. The review described and summarized the crash benefits of PTW ABS from a number of studies (test-track and on-road) over the last decade of potential and real-world reductions in crashes and injuries. Reductions in the number of crashes ranged from 17 percent to 38 percent for all crashes with injuries and 37 percent to 53 percent for fatal or serious crashes. This was reflected also in an overall reduction in insurance material claims of 19 percent to 21 percent for bikes fitted with ABS. Reasons for these benefits were claimed to involve greater opportunities to avoid the crash through improved ability to steer and fully brake around the crash without falling to the ground. That is, ABS enabled the rider to remain on the vehicle during braking and provided a more advantageous collision profile. Thus, the crash severity would have been reduced for the rider and passenger. However, the authors stressed that the evidence for this was rather scant and more research is warranted to understand this phenomenon better. Rizzi and his colleagues also noted the importance of ensuring that the uptake of ABS technology is targeted and appropriate, with an understanding of the acceptability of this technology amongst the target audience.

The SMC FEMA study of rider choice of safety equipment (to be published January 2011) showed that a high proportion of riders would choose an ABS-equipped PTW when purchasing their next bike (81.7%). In addition, this study showed that one out of three will choose combined brake systems (CBS) and one out of five traction control systems. (see Lenné, Oxley, 2011: Rider Openness towards assistive technologies: a review of the literature).

Cairney and Ritzinger (2008) reported that expert opinion was clearly very positive regarding ABS and noted the benefits in providing assistance with braking manoeuvres, particularly in emergency situations.

Implementation, Acceptance

Previous research has shown (see Lenné, Oxley, 2011) that rider opinion towards ABS was rather divided in contrast to the Focus Group Interviews conducted in the framework of 2BESAFE where attitudes towards ABS were mostly positive:

- The Focus Group discussions clearly showed that ABS meets with great acceptance with the PTW riders. It is seen as the assistive system with the biggest potential in enhancing PTW rider safety. The interviewed persons considered ABS as necessary and good tool especially when road conditions are bad (slippery surfaces, road grit, etc.) or in sudden and abrupt braking situations
- Some of the riders said that the system would undermine the development of braking skills and leave riders 'worse off', or operate in a manner that the rider did not expect, thereby disrupting the rider's braking routine.
- Some also argued that braking manoeuvres controlled by the system may not be optimal (would not reduce the braking distance) and could even be detrimental in some scenarios, whereas a skilled rider could stop more effectively (and, in an inclined position ABS would be useless). However, it was noted that most riders do not attain this skill level, and that even highly skilled riders experience difficulty in performing required manoeuvres in emergency situations.
- Awareness of riders for assistive technologies, which have demonstrated road safety benefits (e.g. ABS) has to be improved. The advantages of such a system and their possibility to support riders in situations of particular danger (e.g. braking abruptly) need to be promoted systematically and more detailed information about how the system operates exactly has to be given.

Challenges:

- Riders want systems they can rely on. They repeatedly expressed the need for systems they can trust otherwise acceptance would be very low. ABS is seen as one of the systems they know the best (also from experiences with multi-track vehicles) and as a technology which is advanced and trustworthy.
- Riders generally dislike the idea of equipment which comes as an add-on rather than as a factory-fitted option (this was also the case for ABS, even if some showed willingness to re-fit ABS on their motorcycle they mainly argued for standard solutions).
- Many riders regard the technologies as too expensive. Riders generally saw ABS positive in this regard with the exception of small motorcycles or scooters where the fitting of ABS might make the motorcycle a lot more expensive.
- The challenge is to make this technology more widely available on smaller machines suited to inexperienced riders who would likely to benefit greatly from this technology (often don't brake exactly - they use the front brake too much and run the risk of falling off the bike - ABS opens the brake and avoids "over-braking").
- Interviewees stated that the Scooter- Lobby doesn't want ABS on scooters. They estimated that if all scooters were equipped with ABS there would be a lot less fatal accidents.

Expected Impact(s)

Studies of fatal crashes, insurance claims, and test track performance all confirm the importance of anti lock brakes. The rate of fatal crashes is 37 percent lower for motorcycles equipped with optional ABS than for those same models without ABS (Teoh, 2011). Collision insurance claims for motorcycles with ABS are filed 22 percent less frequently than for motorcycles without it (Highway Loss Data Institute, 2009). On the test track, both new and experienced riders stop more quickly with ABS. Stopping distances improve on wet and dry surfaces alike (Winkelbauer, 2004; National Highway Traffic Safety Administration, 2006).

Riders' perspective

★★★★★

The riders' associations support all efforts deployed to make advanced braking systems cheaper, lighter, better and more reliable, but strongly oppose all plans to make ABS/CBS mandatory on all vehicles, as they do not answer the needs of all users, and can prove counter-productive for safety in some cases (e.g. off-road bikes).

Priority

According to both expert statements and scientific evidence, ABS and other advanced braking systems should receive highest priority and should be implemented on a mandatory basis as soon as possible.

Future Brake Systems

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★★☆

Today's motorcycle antilock brake systems efficiently prevent wheel lock in straight-ahead conditions and for medium roll angles. For high roll angles, the break system parameters (e.g. brake force distribution, brake pressure gradient, control strategies) need to be adapted to cornering in order to prevent the PTW rider from losing control. Therefore, the brake systems profit from knowing the roll angle. Also corner lighting, chassis systems and future advanced dynamic control systems would benefit from the measurement of the roll angle. But known methods for calculating the roll angle are either too imprecise (integration of roll velocity) or too expensive (mechanical gyroscopes, fiber optic gyroscopes) for mass production purposes.

Example:

At the Darmstadt University of Technology, the institute of automotive engineering developed a method for calculating the roll angle. This method is valid for steady-state as well as transient driving conditions. Besides, it is inexpensive as mass-produced automotive sensors (e.g. acceleration sensors, rate sensors) can be used. The method's acceptability for future brake systems has been proved with the help of driving tests.

Seiniger P. et al. (2006). Development of a roll angle sensor technology for future brake systems, p.371

Beneficiaries:

All PTW riders benefit from advanced ABS, because it reduces the number of accident respectively diminishes the accident severity.

Clear definition of the problem

There is clear evidence about improvements achievable by advanced braking systems like ABS and combined braking systems (CBS). It is well acknowledged that these systems still have weaknesses in terms of emergency braking during cornering.

Size of the problem

Sporner and Kramlich (2000) found that 40% of single vehicle accidents and 65% of collision with other vehicles would be positively influenced by ABS. Other sources indicate the combined braking systems and link with ABS are most effective (Tsuchida et al, 2002). Quantitative evidence in terms of crash avoidance for enhanced performance of PTW braking systems during cornering could not be found.

Scientific Background

Advance braking systems are intended to compensate for the built-in failures of humans. In case of emergency, human response is frequently not based on comprehensive considerations. In other words, emergency braking is hardly ever a filly controlled reaction, in most cases one or both brake levers are applied as hard as possible, which leads to locking one or both wheels. The risk of falling is particularly high during cornering, since locking the wheels during cornering is linked with an immediate risk of falling.

Expected impact

As indicated above, improvement of the performance of vehicles for emergency braking during cornering may be expected, but exact quantitative figures could not be found.

Implementation

Implementation of such systems on a mandatory basis by definition within technical standards should be targeted. Currently, only few standards are available for testing the performance of active safety systems.

Acceptance

Experience in the past has shown that active safety systems can successfully be promoted (e.g. "Besser Bremsen" campaign in Germany). However, such effort may be more difficult if only certain features of advanced systems would have to be promoted.

Sustainability

There's a certain risk that riders compensate for improved technical performance of their vehicles by taking higher risks.

Transferability

Since the PTW market is a global one, technical standards are highly transferable.

Costs and benefits

No cost-benefit analysis of improvements of existing advanced braking systems could be found.

Riders' perspective

★★★★☆

The riders' associations support all efforts deployed to make advanced braking systems cheaper, lighter, better and more reliable.

Priorities

According to the figures provided above, implementation of advanced braking systems is very promising in terms of reducing crash counts and severity. However, priority should be given to investigating actual potential for reduction of crash counts and severity of further improving advanced braking systems.

Automatic Stability Control (ASC)

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★★☆	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★☆☆☆
Efficiency	★★★★☆	Sustainability	★★★☆☆

The logical counterpart to ABS in terms of longitudinal acceleration is Automatic Stability Control (ASC). It is a meaningful, additional assistance function particularly on a high-torque motorcycle and when riding under varying conditions with slippery surfaces. ASC prevents the rear wheel from spinning unintentionally when accelerating all-out and thus avoids any loss of side forces and stability which otherwise would make the rear wheel swerve out of control. Lift-off detection and intervention serves furthermore to prevent the front wheel from moving up when accelerating under full power (an event colloquially called "wheelie"). Acting together, these two functions enhance riding stability and thus help to ensure a higher standard of safety on the road.

Example:

BMW offers ASC for many models since 2007; for some of the models it can be retrofitted.

Figure 33: BMW, elements of an ASC systems

Beneficiaries:

Riders or vehicles equipped with ACS. Considering that PTWs also exert collision risk to other road users, they might benefit as well.

Clear definition of the problem

Automatic Stability Control serves to enhance riding stability and thus helps to ensure a higher standard of safety on the road. Depending on the manufacturer, the system might be switched off at any time.

Implementation

Riders were rather critical in this regard. They stated that in some situations systems like Automatic Stability Control (ASC) or Traction Control Systems (TCS) might be helpful (road grit, oil on the road, rain, manhole covers etc.) because it prevents the rear-wheel of sliding off.

A main concern expressed by riders is that ASC systems or TCS might reduce engine output in situations that could be dangerous for motorcycle riders (when bike is in an inclined position, also when driving off in crossings where they have to incline the bike to get around the corner – if engine output is reduced - intervening in the ignition angle to reduce engine power or cancelled fuel injection - and the bike is heavy, it might “fall into” the curve)

Improvements

ACS systems or TCS need to operate smoother and need to be better adapted to the driving characteristics of the individual rider (better programming/management) as it is currently the case (according to the interviewed riders). If interference in the riding task is too big and effects on comfort and dynamics are too severe, acceptance by riders will be very low.

Riders generally dislike the idea of compulsion, particularly with regard to systems which they feel will take essential control away from them. They don’t want to entirely depend on the system (they want to keep the control).

Automatic Stability Control is particularly useful for high-torque machines

Riders were rather sceptical when it comes to the costs of ACS and TCS. They fear that it would make motorcycles considerably more expensive and they are sceptical about whether it is realistic to fit them on small motorcycles or scooters (without increasing the costs).

Riders require better description and information of how ACS or TCS operate.

The advantages of such systems and their possibility to support riders in situations of particular danger need to be promoted systematically

Acceptance

2BESAFE's WP3.3 has analysed acceptance for various assistance systems. In general, acceptance of many of these systems was rather low, also for traction control. Riders indicated that such systems need to be particularly designed addressing the need of PTW as well as the individual rider.

Expected impact

A study published by the Swedish Transport Administration in 2010 estimates a 10% reduction of crash counts by dynamic stability control.

Sustainability

There is a certain risk that riders compensate for gains of objective safety by taking higher risks.

Transferability

Implementation is currently driven by consumer demand. Considerable costs have to be considered, in particular in countries where purchase costs are most critical.

Costs and benefits

It is difficult to determine costs. Sensors and control systems are normally used for multiple purposes. Hence, cost has to be determined by market price. Quantification of safety impact on other impacts could not be found.

Riders' perspective

★★★☆☆

The riders' associations support all efforts deployed to make motorcycles safer and more reliable; however, ASC is still in its infancy, only answers the needs of some riders but not all, and is only useful or beneficial in some configurations and on some PTW types.

Priorities

Experts expect a strong safety impact; hence, ASC should receive particular attention in road safety programs.

7.3. Passive Safety Devices

Method of Assessment of Secondary Safety Systems

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★★★☆	Implementation	★★☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★★

In the last few years, improving passive safety for PTWs has been one of the basic aims of accident research on these types of vehicle. The main problem is the wide range of possible outcomes of a PTW accident, arising from the complex possibilities of the sequence of motion of both rider and motorcycle, and the injury mechanisms involved, which differ very considerably from those seen in car accidents.

To describe a motorcycle collision with a car or other opposing vehicle, five crucial impact variables need to be defined: motorcycle speed, car speed, motorcycle contact point, car contact point, relative heading angle. Because of this complexity, it is not surprising that very few studies are available which have examined all five of these variables. As a result, there is often some confusion in discussion of accident research, and some unavoidable speculation in some aspects of the studies. It is therefore of critical importance to the successful development of any safety device that it is tested not only in the impact configurations likely to give rise to the sort of injuries that the device is designed to prevent in real accidents, but also in other configurations to ensure that there is no increase in the risk of other types of injuries.

Example:

Because of the need to examine motorcycle safety in this critical way, the ISO Standard 13232 ("Motorcycles – Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles") was developed and approved by ISO at a worldwide level in 1996. This comprises eight parts starting with accident data, collection and analysis, which is used to identify the seven most important impact configurations and then the remaining parts define the specialized motorcycle dummy components, test methods, assessment of potential injury from the dummy measurements, computer analysis of 200 impact configurations and reporting.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.152

Beneficiaries:

All PTW riders benefit from a standardized method of assessment of secondary safety systems because the comparability of these systems is enhanced with the help of such a method. Hence, the passive safety concerning the vehicle design and its equipment can be increased.

Clear definition of the problem

The physics of PTWs and the separation between rider and vehicle that often occurs during accidents are not fully understood and are difficult to simulate reliably with current knowledge. Without a reliable tool for the assessment of protective systems, improving secondary safety is more difficult.

Size of the problem

All secondary safety equipment (on motorcycle, personal protective equipment, other vehicle design, infrastructure design) can benefit from a better understanding of impact configurations.

Expected impact

The expected impact is very high: secondary safety is key in all accidents where injuries are expected to occur. All elements of roadside furniture, other vehicle design, helmet design and protective clothing design could benefit from a reliable assessment method.

Implementation

Currently, implementation is driven by consumer demand. The number of vehicles available with airbags is very small and limited to relatively expensive vehicles.

Acceptance

A respective statement from 2BESAFE's D9 (p10) reads: "Generally acceptance was higher for systems that do not actively interfere with the riding task but work in the "background". Further, it appears riders trust systems that they already know and/or consider reliable, like ABS and airbags."

Sustainability

Standards are a measure to ensure sustainability.

Transferability

Transferability is high, with standards and testing methods that can easily be adapted in other areas across the world.

Costs and benefits

Costs in research, modelling, standardization are expected to be high, coming from several sources, with a development time of several years. Expected benefits in the long term are also expected to be high, affecting all areas of powered two-wheeler safety.

Riders' perspective

★★★★☆

The riders' associations support this measure because it contributes to creating a road environment that takes into account the needs, characteristics and vulnerabilities of powered two-wheelers and contributes to the safety of riders.

Priorities

Standards for assessing passive safety devices for cars are a matter of course, even if some of the systems are not addressed directly, i.e. testing targets passenger loads instead of the explicit functioning of the various contributing passive safety systems. Such standards should be in place also for PTW.

Safety Belts

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

This measure involves designing appropriate safety belts for PTWs, with a similar effect as those of other road users' use. In comparison to cars, PTWs have a very low level of passive safety. The possibility of securing a motorcyclist during a collision by means of a restraining system is currently only used on three- or four-wheeled motor vehicles.

Examples:

In 1997, the European Commission has adopted the Directive 97/24/EC on certain components and the characteristics of two or three-wheel motor vehicles. Chapter 11 is about safety belt anchorages and safety belts of bodied three-wheel mopeds, tricycles and quadricycles and contains instructions for the anchorage of safety belts and requirements for safety belts.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

The Bern University of Applied Sciences and the Vauffelin Dynamic Test Center (DTC) evaluated and tested a restraining system for motorcycles. In a test series of motorcycle skidding trials and motorcycle impact trials with light and also heavy motorcycles into the side of stationary motor cars, the effectiveness of the belt system could be proved.

Beneficiaries:

Passive safety measures like safety belts are designed to help protect riders in the event of an accident and can therefore improve motorcycle safety. They are especially effective in the cases where the motorcycle hits a fixed object frontally at right angle. But today, the safety belts for motorcycles are still in an experimental stage. There is also the need of installing an energy absorbing element in the front, which can limit the effects on the motorcyclist while he is being stopped by the belt.

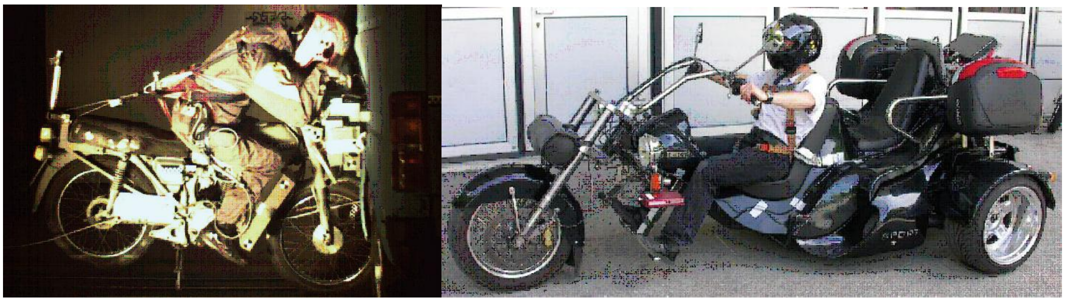

Figure 34: Safety belts[30]

[30] Source: ifz (2008). Proceedings of the 7th International Motorcycle Conference 2008, pp.425, 429

Clear definition of the problem

There are not many passive safety systems for PTWs. Hence, once an accident takes place the PTW rider is not protected to the degree that the car driver is. In addition, there is lack of separation between the rider and the road environment leading to more severe accidents for PTWs than other road users.

Size of the problem

This measure – if effective – will improve PTW rider accident severity.

Scientific Background

The Bern University of Applied Sciences and the Vauffelin Dynamic Test Center (DTC) evaluated and tested a restraining system for motorcycles. In a test series of motorcycle skidding trials and motorcycle impact trials with light and also heavy motorcycles into the side of stationary motor cars, the effectiveness of the belt system could be proved.

There is still not enough data or a prototype system ready to enter the market to be certain that this measure works.

The measure if effective will reduce severity of particular types of PTW accidents.

Expected impact

It will reduce specific types of PTW accident severity.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

Testing the safety belt under several scenarios and a before and after accident study would be a measure of success.

Risk compensation could be an issue.

Implementation

Barriers mainly involve technological issues as well as the distinct dynamics of PTWs, and the different types of effects under different types of crashes.

It should reduce accident severity in particular accidents but not increase in other types of accidents.

The measure should be implemented only after thorough testing.

Awareness could be raised through media, training schools, and PTW sellers or garages.

Acceptance

Riders' enthusiasm about use of helmets is rather limited; in general, protective equipment does not receive strong appreciation by large groups of riders. In some places in the world, helmet obligations are abolished due to pressure from rider associations. It may be assumed that some riders will use a seat belt, but a large majority might reject the idea, in particular if use should be made mandatory.

Sustainability

There is a risk of behavioural adaptation as there was with passenger cars.

Transferability

The implementation of the measure – once proven to be effective – is possible anywhere and in Europe.

There might be a higher or lower degree of behavioural adaptation depending on rider mentality which is usually correlated with rider nationality.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations strongly oppose all systems that tie riders to their vehicle, such as seatbelts or leg protectors. Seatbelts could only provide limited protection in frontal collisions and no protection in other configurations, are incompatible with the use of crash helmets due to the weight of the helmet applying excessive and potentially lethal forces to the neck while the body is held back during strong decelerations, and by keeping the rider in the upright position put her at risk of being crushed by her own vehicle during an fall.

Priorities

The measure should not be implemented before safety benefits have been comprehensively assessed and potential risks are eliminated. Technical implementations due to complexity of PTW dynamics may be considered a large challenge.

Motorcycle Airbags

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★★★☆
Total impact	★★★☆☆	Implementation	★☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	★★☆☆☆	Sustainability	★★★★★

Motorcycle airbags are designed to reduce the incidence and severity of injuries by absorbing the energy of an impact. In the event of a frontal collision, the airbag is designed to inflate and absorb some of the rider's kinetic energy. As a result, the force of impact between the rider and the vehicle or the road may be reduced.

Examples:

Honda has developed an airbag system including crash sensors for touring motorcycles. The airbag is designed to deploy in the case of a frontal collision in which the rider could be thrown forward from the motorcycle. The principal components are: an airbag module (it contains the airbag and the airbag inflator and it is positioned in front of the rider), an airbag ECU (it analyzes impacts and determines whether or not to inflate the airbag) and crash sensors (they detect changes in acceleration caused by frontal impacts).

http://world.honda.com/MotorcycleAirbag/

DEKRA Automobil GmbH from Stuttgart, Germany has designed an airbag prototype for a mid-sized touring motorcycle. Compared with the situation without airbag, its performance was tested using sled tests and full-scale crash tests. The results showed reductions in injury severity and a positive influence of the airbag on the rider´s movement into an upward direction over the roof of the impacted car.

http://www.dekra.de/c/document_library/get_file?folderId=52720&name=DLFE-1230.pdf

In its policy orientations up to 2020, the European Commission calls for further research and technical development of airbags to reduce the consequences of accidents.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

Beneficiaries:

Passive safety measures are designed to help protect riders in the event of an accident and can therefore improve motorcycle safety. In the known design, motorcycle airbags are the most effective in those cases, where the motorcycle hits a fixed object frontally at right angle (e.g. hitting a crossing passenger car from the side).

Figure 35: Honda's motorcycle airbag system[31]

Clear definition of the problem

Motorcycle riders are physically exposed.

Scientific background

For PTW, one of the promising technologies is vehicle-mounted airbags, although the safety benefits of this ITS for PTW riders are still somewhat contentious, particularly with concerns raised about the potential for these to increase head and neck injury upon deployment (Ulleberg, 2003). Airbags have also been shown to be effective in reducing the incidence of being thrown from the PTW in multiple-vehicle collisions (e.g., Kuroe, Namiki & Iijama, 2005; Yamazaki, Iijama & Yamamoto, 2001).

Implementation

Like with other systems which don't interfere actively in the riding task (active accelerating, braking, blinking, warning, etc) acceptance is generally higher also with airbags. Riders assessed them as positive and useful. They stated that they are especially useful in emergency situations where "the rider is not able to interfere anymore."

Makes sense especially if integrated in motorcycle protection clothes (Airbag Jackets).

Consider side-protection of PTW riders. Promote the development of side-airbags as falling on the side is one of the main problems.

Costs:

Airbag Jackets or Motorcycles equipped with Airbags (like Honda Gold Wing) are very expensive and people won't buy for instance Airbag Jackets.

Another problem is that they might make the protective clothing even heavier. (Weight in general was identified as problem when it comes to assistive systems. shouldn't make motorcycles or equipment (like helmets and clothing) too heavy. Too heavy clothes, helmets or bikes would be a problem for people who weight less (e.g. some of the women mentioned this problem).

Trusting on the system:

Riders want systems they can rely on. It must be ensured that Airbags work well and don't do any harm to the rider. Doubts were expressed whether Airbags are reliable at this stage.

Legal situation:

When thinking about Motorcycle Airbags and Airbag-jackets it is important to differentiate between motorcycle manufacturer and manufacturers of motorcycle equipment (like clothing, helmets for Airbag-Jackets or neck-protections). The motorcycle manufacturer is not able to oblige the purchaser of a motorcycle to buy and wear a specific protection clothing with e.g. Airbag or neck-protection.

PTW and airbags must be designed to take into account that the position of the rider is not always upright such that there may be smaller distances between the rider's face and the airbag compared with that typical for car drivers, and that the presence of a pillion passenger will affect the forward force of the rider (Takeshi, 2000, Bayly et al., 2007, in: Lenné, Oxley, 2011)

[31] Source: http://www.cyclechaos.com/wiki/images/9/9b/Motorcycle_Airbag_E.pdf, 24 Aug. 2009

Acceptance

A respective statement from 2BESAFE's D9 (p10) reads: "Generally acceptance was higher for systems that do not actively interfere with the riding task but work in the "background". Further, it appears riders trust systems that they already know and/or consider reliable, like ABS and airbags."

Sustainability

Airbags, like other measure increasing objective safety might seduce to taking higher risks, such effects have not been researched.

Transferability

Currently, the implementation is fully driven by consumer demand. Purchase costs for additional equipment are an issue and may be critical.

Costs and benefits

A macroeconomic cost-benefit study could not be found.

Riders' perspective

★★☆☆☆

The riders' associations support the development of safety technologies that answer the needs of riders, but today motorcycle airbags are only experimental; and if deployed will only provide protection in frontal collisions in an upright position, but not in other accident configurations.

Priorities

Experts consider motorcycle airbags a highly sustainable and transferable measure targeting a major problem. Due to technical constraints expected by experts, implementation is rated rather low resulting in a moderate overall rating.

Protective Cages

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★☆☆☆	Transferability	★★☆☆☆
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★★★

In an automobile, the protective cage is that part of the body structure that surrounds the passenger compartment and provides impact and crash protection for passengers during a collision or roll-over. The same system can be adapted for PTWs, too, resulting in an increased rider safety.

Example:

An example of a scooter with a protective cage is BMW's C1. In this vehicle, the passenger is belted with a lap/shoulder belt and uses an additional shoulder belt from the other side. The C1 has a deformable zone at the front and users are allowed to ride without a helmet. The C1 performed quite well in crash tests, in particular, it provided superior leg protection compared to other PTWs and offered some weather protection. But as a result of the safety cell concept, the C1 had a high centre of gravity and resulted in an unfamiliar riding experience compared to other PTWs.

Beneficiaries:

Protective cages improve motorcycle safety as they protect riders in the case of an accident. To gain the best benefit from this measure, the vehicle has to be equipped with safety belts, too.

Figure 36: BMW C1 scooter with protective cage[32]

Clear definition of the problem

The absence of a protective cage around the motorcyclist means that accidents carry a higher risk of injury compared to close four-wheeled vehicles. A protective cage around the motorcycle can alleviate the problem.

Size of the problem

The protective cage only offers protection in the case of head-on collisions with a stationary object or a vehicle. Head-on collisions represent only 28,9% of motorcycle accidents (MAIDS, 2009). Protective cages are only expected

Scientific Background

No scientific study of the BMW C1's specific accident data exists.

Expected impact

Protective cages require the use of seatbelts to provide the maximum protection they are designed for, which is not compatible with the use of a crash helmet due to the excessive forces applied by the helmet's weight to the wearer's neck during strong deceleration. This is reflected by the regulatory approach followed in the BMW C1's case, where many countries (Germany, France, Switzerland, Italy and Spain) required riders to use the seat belt or wear a helmet, but not both at the same time. Therefore, users not wearing helmets would face a higher risk of injury in the majority of accident scenarios, where the collision does not occur head-on.

Implementation

Implementation of the measure would require research and development on the part of motorcycle manufacturers, in order to design and release a product using the protective cage concept.

The sales history of the BMW C1 provides an insight to the viability of the concept. After its launch in 2000, the C1 sold more than 10,000 units in 2001, only 2000 in 2002, and ceased production in 2003. BMW abandoned the concept, and no other manufacturer has revived it since.

If the vehicle is designed for the use of seat belts without a helmet, traffic law must be amended to allow for its use. Failing to do so would make the concept less desirable to users.

Acceptance

The concept, although genius from the technical perspective, did not receive sufficient interest on the market.

Sustainability

Once the concept is proven, and a market has been established, this type of vehicle can stay on the market as long as customer demand sustains it.

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[32] Source: http://www.motorcyclespecs.co.za/Gallery/bmw%20c1-200.jpg, 10 Jun. 2010

Transferability

Transferability in Europe is high due to the single market, but can be impaired by differing regulations regarding the use of the seatbelt and helmet across Member States. Transferability to other countries also depends on regulatory issues.

Costs and benefits

The user would face higher purchase costs due to R&D and additional materials needed for construction.

Riders' perspective

★★★★★

The riders' associations support the development of safety technologies that answer the needs of riders, but there is no evidence that protective cages make a user safer; the measure does not answer the needs of all riders and cannot replace personal protective equipment.

Priorities

The concept of PTWs with protective cages is a very interesting one from various perspectives; however, consumers did not show sufficient interest.

7.4. Advanced Rider Assistance Systems

Intelligent Transport Systems have the potential to significantly improve road safety of all road users. During the last decade, Advanced Driver Assistance Systems (ADAS) and In-Vehicle Information Systems (IVIS) development is one of the main research areas of the automotive industry. However, some ITS applications will need specific development and adaptation to enable them to be used on PTWs, due to their intrinsic characteristics. But the application of such technologies in motorcycles and even clean motorbikes (electric) is currently lacking behind and should be undoubtedly studied further.

Therefore, the project SAFERIDER was launched. The aim of this project is to study the potential of ADAS/IVIS integration on motorcycles for the most crucial functionalities and develop efficient and rider-friendly interfaces and interaction elements for riders comfort and safety. ADAS consequently become Advanced Rider Assistance Systems (ARAS) and IVIS become On-Bike Information Systems (OBIS). In Advanced Rider Assistance Systems various sources of information (navigation systems, other ITS devices, information from the instrumentation panel) are presented to the rider in both visual and auditory form. Human error in the riding task and the workload of the user should be reduced. Thus, ARAS shall maximize the amount of information available to the user while minimizing distraction.

ARAS has already been implemented in the Yamaha ASV-2 system. This system incorporates the information from a range of ITS technologies (curve speed warning, forward collision warning, etc.) and it also combines information from the vehicle itself (speed, position, etc.).

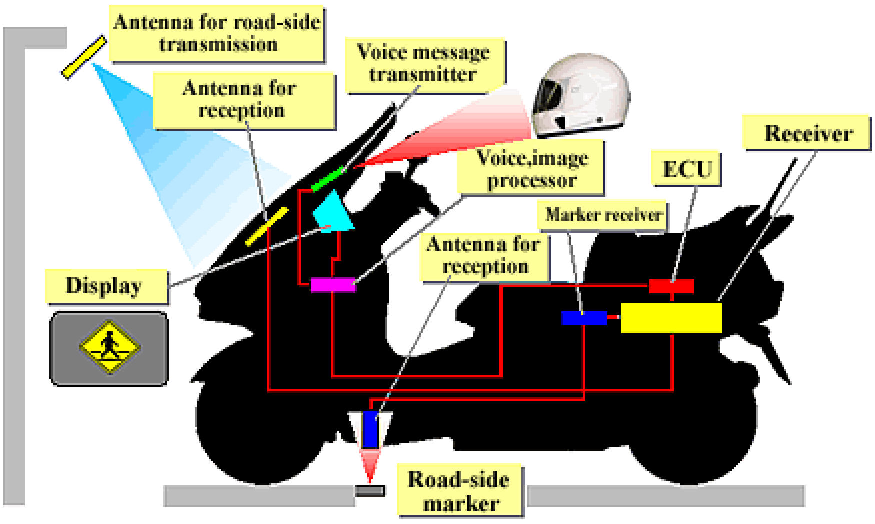

Figure 37: Yamaha's rider support system[33]

Nevertheless, many obstacles have to be overcome before ARAS will be implemented successfully. The vast majority of these issues is targeted in the project SAFERIDER:

- To develop priority Use Cases for ARAS/OBIS implementation on PTWs.
- To define the functionalities of the prioritized ARAS/OBIS for PTWs of different levels, based on accident analysis data and naturalistic driving studies.
- To design and develop ARAS/OBIS prototypes for the selected functionalities.
- To design an optimal HMI concept and develop warning/ information provision elements for the prototypes, as well as for potential combinations of their output.
- To technically verify the developed ARAS/OBIS and integrate them to different motorcycles and motorcycle simulators.
- To estimate the safety impact and user acceptance of the prototypes in a series of pilot applications.
- To develop a Design Guidelines handbook for ARAS/OBIS integration and HMI design for motorcycles.
- To develop riders training tools for optimal ARAS/OBIS usage.

Next to SAFERIDER, there are various other projects which focus on Advanced Rider Assistance Systems. Some of them, like SIM (Safety in Motion) or PISa (PTW Integrated Safety Project), aim to develop an innovative vehicle with new active, preventive and passive safety devices or to implement reliable and fail-safe integrated safety systems for a range of PTWs. Others, like APROSYS (Advanced Protective Systems), focus on scientific and technological development in the field of passive safety.

http://www.saferider-eu.org/

http://www.sim-eu.org/

http://www.pisa-project.eu/

http://www.aprosys.com/

APROSYS PISa Safety In Motion

[33] Source: http://www.yamaha-motor.co.jp/global/news/2000/11/15/asv2-05.html, 19 Oct. 2009

Figure 38: Project logos[34]

In the following chapter, some of the most promising ARAS and OBIS are presented.

Collision Warning and Avoidance Systems

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★★☆☆
Total impact	★★★☆☆	Implementation	★☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

Collision warning and avoidance systems monitor the area surrounding the vehicle and if an emergency arises, either the user is alerted (warning systems) or the system provides both an alert and an intervention via the brakes of the vehicle (avoidance systems). Laser or radar sensors detect the presence of other vehicles.

Example:

In the course of the SAFERIDER project, a Frontal Collision Warning system was developed, a demonstrator was built and tested.

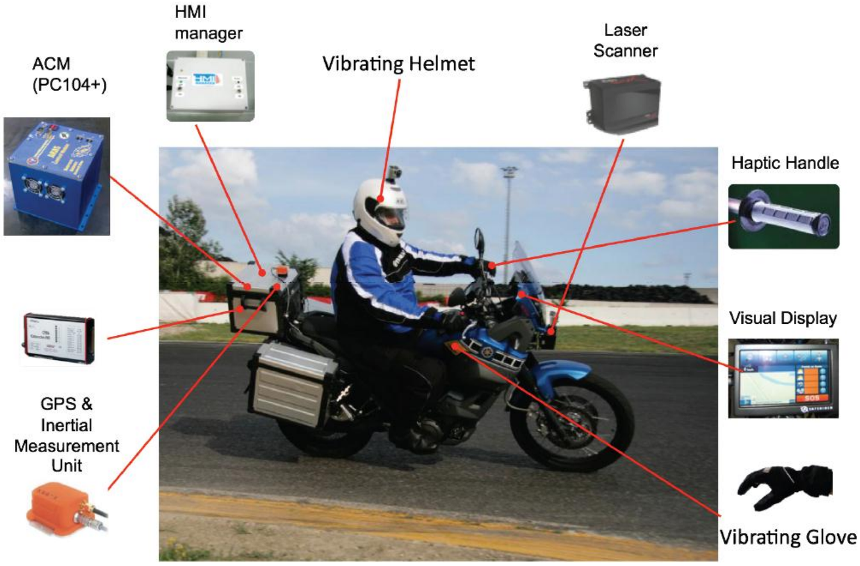

Figure 39: PTW detection by FCW system[35]

Mobileye provides FCW, which are capable of detecting PTWs. In terms of PTW this might be concerned a passive PTW implementation, which is also beneficial for riders.

Beneficiaries:

Collision warning and avoidance systems have a potential to reduce the incidence of multiple vehicle crashes, particularly rear end collisions, but also collisions with slowly moving road users, such as pedestrians and cyclists. If FCW is mounted on other vehicles, PTW riders may benefit from these systems' abilities to detect PTW moving ahead.

[34] Sources: http://www.saferider-eu.org/pilots.html, 02 Jul. 2010
http://www.aprosys.com/, 02 Jul. 2010
http://www.pisa-project.eu/, 02 Jul. 2010
http://www.sim-eu.org/index.html, 02 Jul. 2010

[35] Sources: MOBILEYE C2-270 product brochure from www.mobileye.com

Figure 40: PTW detection by FCW system[36]

Clear definition of the problem

- Overcome the limitations of the rider's field of view (due to helmet, side mirrors) and act on the recognisability of the PTW by drivers
- Prevent a crash by means of a timely warning, enabling thus a timely reaction by the rider
- Raise the rider's awareness about a risk of collision, with keeping his/her eyes on the road and thus not distracting him/her from the main task

Size of the problem

According to the MAIDS report, "69% of the OV [other vehicle] drivers attempted no collision avoidance maneuver" in motorcycle-OV crashes: this data suggests that riders should anticipate preventive actions, not relying on other road users' counteractions.

Scientific Background

Data supporting the implementation of this specific measure are so far based on the automotive field. Previous research projects (Saferider, Watch Over, PReVENT) have demonstrated that if the evidence of an approaching vehicle is presented to a rider, the rider's reactivity raises. Some researches undertaken in the scope of 2BESAFE give support to this fact (e.g. WP1 accident analysis reports insufficient visibility along road sections among the main crash causes)

Because it reduces reaction times and raises situation awareness.

It enables riders to have a better and quicker understanding of a critical situation, but it does not solve the problem by itself

Implementation

- The size and weight of the equipment must be adequate to be installed on a motorbike, must be integrated, waterproof and non invasive for the rider.
- Rider acceptance of the system: it must be accurate and coherent, otherwise it will not be trustworthy for the user
- The risk threshold must be determined in a very accurate way in order to avoid false alarms.
- To be too obtrusive and keep the rider out of the decisional loop

Expected Impact(s)

- Mostly in the safety area
- It will support riders in be more aware and responding in critical situations
- As mentioned before, WP1 accident analysis support this evidence.

[36] Sources: MOBILEYE C2-270 product brochure from www.mobileye.com

- By the collision reductions among those have installed the system
- In case the system is not accurate there is a risk of “crywolf” effect, that would turn out into a lack of attention by the rider towards the warning system

Acceptance

Collision warning systems were included in the survey of 2BESAFE's WP3.3. Collision warning received very low ratings by riders.

Sustainability

Behavioural adaptation to the system might be an issue.

Transferability

It is possible but only with validation and support of policy makers and manufacturers. There could be a difference in acceptance according to the country, this contributing to the whole impact of the measure.

Costs and benefits

No cost-benefit data provided.

Riders' perspective

★★☆☆☆

The riders' associations support the development of safety technologies that answer the needs of riders, but today collision warning and avoidance systems are only experimental; and need to be developed and tested further before being deployed.

Priority

Although these systems are properly working for cars, PTW riders seem not to be interested. Research will be needed to fully adopt these systems to PTWs.

Curve Speed Warning

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

The curve warning is to warn the rider that there are high risk factors when negotiating the curve ahead. This either infrastructure or vehicle-based system provides alerts or warnings in case of excessive speed in curves. Upcoming changes in the road geometry are communicated to the rider early enough. Speed recommendation is given, which is the speed that the PTW should have in the next upcoming few seconds.

Example:

These systems implemented in motorcycles are unknown to the authors.

Beneficiaries:

With the help of these systems, run-off-the-road collisions due to excessive speed can be avoided. This measure is especially beneficial for motorcycle riders since they normally cruise at the highest speed among PTW riders.

Clear definition of the problem

Reduce the crashes deriving from excessive speed in approaching a curve

Size of the problem

Curves (curvature change rate), combined with inappropriate speed, are proven to be a critical factors in determining the conditions of a crash.

Scientific Background

- A small body of evidence exists about the effectiveness of such systems in the PTW domain; a relevant exception is provided by the results of the Saferider project, though tests have only been conducted on prototypes.
- Because it enables rider to timely adapt his/her behaviour in case of wrong estimation of a curve.
- It enables riders to have a better and quicker understanding of a critical situation, but it does not solve the problem by itself – the aim of this kind of systems is to draw the rider's attention towards the oncoming risk and thus trigger the appropriate counteractions.

Implementation

- The size and weight of the equipment must be adequate to be installed on a motorbike, must be integrated, waterproof and non invasive for the rider.
- Rider acceptance of the system: it must be accurate and coherent, otherwise it will not be trustworthy for the user
- The risk threshold must be determined in a very accurate way in order to avoid false alarms.
- To be too obtrusive and keep the rider out of the decisional loop

Expected Impact(s)

- Mostly in the safety area
- It will help riders in avoiding taking risky behaviours while approaching curves
- By the reduction of injuries and deaths in accidents occurred in curves
- In case the system is not accurate there is a risk of "crywolf" effect, that would turn out into a lack of attention by the rider towards the warning system

Acceptance

Curve speed warning was included in the survey of 2BESAFE's WP3.3. Curve speed warning among all warning systems received the lowest rating by riders.

Sustainability

Behavioural adaptation might be an issue.

Transferability

Currently, implementation is driven solely by consumer demand. Transfer requires, depending on the system, information about infrastructure, which has to accurate and up to date. Such data is expensive to both collect and keep updated.

Costs and benefits

No cost-benefit data provided

Riders' perspective

★★★★★

The riders' associations support the development of safety technologies that answer the needs of riders, but today curve speed warning systems are only experimental; and need to be developed and tested further before being deployed. Furthermore, they would only answer the safety needs of some riders, to prevent single vehicle accidents due to run-offs on secondary roads outside of build-up areas.

Priorities

It seems that neither the riders not experts are strongly in favour of curve speed warning.

Tyre Pressure Monitoring Systems

Expert Assessment			
Overall		★★☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	★☆☆☆☆	Sustainability	★★★★☆

Vehicle diagnostic systems monitor the status and performance of various vehicle components and systems, and alert the user to potential malfunctions. Hence, Tire Pressure Monitors give indication and assurance to the driver that tires will perform according to expectations. When tire pressures become low the vehicle handling characteristics are affected and become unpredictable - leading to an accident.

Example:

There are a number of tire pressure monitors on the market which provide either a visual or an acoustic warning of falling tire pressures. The most inexpensive ones are Flag Indicating Tire Pressure Monitors, which are fitted on the tire valve externally by removing the existing valve dust-cap and screwing the indicator in place. Next to these external mounted indicators, Digital Tire Pressure Monitor Systems using internal wheel mounted pressure sensors are available, too.

http://www.tire-pressure-monitors.com/

Beneficiaries:

While vehicle failure is rarely cited as a causal factor of motorcycle crashes, mechanisms that detect and alert the rider of potential problems will contribute to motorcycle safety. These systems will be especially relevant to infrequent riders who may not regularly maintain their vehicle.

Figure 41: Tire pressure monitoring system[37]

Clear definition of the problem

Riding is often a seasonal task, which requires an appropriate maintenance of the vehicle; poor maintenance of tyre pressures may impair the vehicle's safety and therefore lead to falls or difficulties in controlling the motorcycle. It has to be considered that PTW riding in wide areas of the EU is a seasonal task, many PTWs spend a long time waiting in garages to be used at the beginning of the next season. Tyre pressure is likely to significantly decrease during this period and will impair the dynamic properties of the vehicle, if not adjusted.

[37] Source: http://www.tire-pressure-monitors.com/, 20 Jul. 2010

Size of the problem

To some extent, this problem is related to the accidents involving unlicensed and therefore inexperienced or occasional riders. Practical experience shows that riders are somewhat likely to ignore recommendations from vehicle and tyre manufacturers in term of periodic inspection of tyre pressure.

Scientific Background

Tyre pressure monitoring has been introduced into the automotive domain, though there is no quantified evidence yet about the benefits it may bring in terms of safety.

This measure suggests that riders may be able to easily check for the condition of their motorcycles' tyres before riding and, in case pressure is found to be insufficient, to properly adjust it.

The aim of this measure is to provide riders with a tool that may ease the motorcycle's maintenance, though it does not suggest that a TPMS may replace an appropriate training.

Expected impact

There is no data available, to which extent inappropriate tire pressure contributes to PTW accident counts and severity. TPMS will, like other vehicle-based measure penetrate the market as quick as new vehicles replace older ones.

For vehicles with a TPMS it may be assumed that all accidents related to poor driving dynamics of the vehicle resulting from inappropriate tyre pressure are eliminated.

Implementation

Should the TPMS be compulsory, manufacturers would bear an extra cost. Aftermarket TPMS may be a back-up solution for already circulating PTWs.

The precision and calibration of TPMS should be considered as a risk factor: poor calibration may lead to unreliable information about pressure and therefore to inappropriate adjustment performed by the inexperienced rider. That would result in a counterproductive measure.

Riding schools and the related training should stress the importance of monitoring tyre pressure, and possibly suggest which tools may be used to this aim. The use of TPMS will follow.

Acceptance

Tire pressure warning was included in the survey of 2BESAFE's WP3.3. TPMS among all warning systems received the highest rating by riders.

Sustainability

TPMSs will be most sustainable as long as riders do not fully rely on them, these systems are properly working.

Transferability

Currently, TPMS implementation is driven by market demand; however, they might likely an issue of legal obligation. As soon as majority of manufacturers is able to deliver TPMS, it is very easy to implement them also on a mandatory basis. Market penetration only driven by marketing, awareness raising and/or advertising might in some places be difficult due to additional cost, which might also be an issue for implementation on mandatory basis.

Costs and benefits

No quantitative data is known.

Riders' perspective

★★★★★

The riders' associations support the development of safety technologies that answer the needs of riders, and constant and reliable tyre pressure readings contribute to vehicle safety.

Priorities

Although this measure is considered highly sustainable and well accepted, a lack of knowledge on the actual size of the problem precludes a high rating.

eCall

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★★★☆
Total impact	★★☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★★★★★

eCall is the abbreviation for Emergency Call and represents an adaptation and implementation of an In-Vehicle Information Systems (IVIS) as an On-Bike Information Systems (OBIS). The PTW has the capacity to detect a crash or fall, to localize it accurately and to report it automatically to the emergency services. Based on this chain, the time interval between the accident occurring and the arrival of the emergency services can be minimized, especially when the involved persons are not able to submit an emergency call or the crash is not noticed by other road users.

Example:

These systems implemented in motorcycles are unknown to the authors. But in the European Commission’s road safety policy orientations up to 2020, the use of relevant ITS applications – mentioning eCall as example – is suggested.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

Beneficiaries:

eCall has a positive impact on the reduction of traffic deaths and reduction of injury severity as the time interval between the accident occurring and the arrival of the emergency services can be minimized

Clear definition of the problem

Although the number of accidents has drastically decreased over the last decade, accidents still happen. As PTWs become more sophisticated, riders feel safer to rider alone for longer journeys (i.e. leisure). Therefore, in case of an accident, the rider may not be in a position to communicate the accident. In addition, if the rider is in a position to communicate he/she might be in a shock and not able to give clear instructions about his/her location and a clear picture of what happened. Most importantly, the time for emergency services is significantly reduced.

Size of the problem

The problem is an interweaving of factors ranging from vulnerability issues to riders that like to rider alone. The latter is no problem at all but when an accident takes place, it instantly becomes an important factor and “player” for the rider’s safety and wellbeing.

According to the EU Commission, eCall will save around 2,500 lives per year throughout Europe.

Scientific Background

Within the framework of several European projects, the development and deployment of eCall services was investigated (e.g. E-MERGE, InSafety and GST RESCUE). The eCall system developed with E-MERGE was a pan-European system with the pan-European call number (112). Details provided were about the location, time, and severity of accident and the identification number of the vehicle. This work is further developed and refined within the eCall Driving Group.

Implementation

eCall service could be implemented in most vehicles. An important aspect to be considered is the sensitive data protection issues arising. Extra care should be taken into account by all participating stakeholders.

Expected Impact(s)

Greatest impact is anticipated to safety. A decrease of 2,500 accidents is anticipated by the implementation of this measure.

Acceptance

Acceptance is anticipated to be higher among the related stakeholders and governmental agencies and public bodies. Some riders could be hesitant to use such a system because they might believe it threatens their privacy. In 2BESAFE's WP3.3, riders rated eCall in second place of the fully autonomous systems (behind ABS).

Sustainability

Sustainability is not an issue for emergency call as it is a straightforward service with probably limited interaction with the rider. Future version could provide more data and be enriched with other telematic services but its usability value will sustain.

Transferability

Pan European implementation of this measure is easier than others; however, data protection issues should be taken into serious consideration.

Costs and benefits

The related costs (i.e. installation of infrastructure, communication services, etc.) should be sponsored by governments and local authorities and surely will be surpassed by the immediate benefits of such a service. An eCall device for a PTW will approximately cost about 400-500 Euros and may be considered a major extra cost, taking into account the ABS penetration and acceptance of half the price of an eCall PTW system.

Riders' perspective

★★☆☆☆

The riders' associations support the development of safety technologies that answer the needs of riders, but today eCall for motorcycles does not exist; and if deployed will only answer the needs of some riders, for single vehicle accidents on roads with low traffic and outside of build-up areas.

Priorities

Implementation of eCall receives high priority by the European Commission, above descriptions and expert rating provide no indication for a change of this policy.

Adaptive Cruise Control

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	☆☆☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

• Like conventional cruise control, Adaptive Cruise Control (ACC) maintains a speed set by the driver. It differs in that it also automatically maintains its distance from vehicles in front of it even if they slow down — within limits. The current systems use radar or laser-based sensors mounted in the car's front bumper or grille to monitor the road ahead. Drivers can establish the following distance between themselves and any cars in front of them by selecting one of several interval settings. If the vehicle ahead slows, the adaptive cruise control is capable of slowing the vehicle, using some combination of throttle control, transmission downshifting and light braking. If the lead vehicle speeds up again or moves to another lane, the adaptive cruise returns its vehicle to the preset speed.

Example:

These systems implemented in motorcycles are unknown to the authors.

Beneficiaries:

ACC systems reduce the strain on the PTW driver. Because ACC maintains a safe distance to the vehicle immediately ahead, the driving task is much more relaxed, with reduced symptoms of fatigue.

Clear definition of the problem

Semi-automatic management of speed with respect to safety distance is an Advanced Riding Assistance Systems (ARAS) which may help riders keep at safe distance from the forerunning vehicle; yet, riders often dislike delegating control of their motorcycle to automation.

Controlling speed is a continuous task to riders. A system maintaining speed at a predefined level and reducing speed when time headway falls under a predefined value may take this burden off the rider and leave more attention to other tasks. ACC may be used, in case the system is working at the respective speeds, be used almost anywhere from urban low speed area to long distance trips on highways. Using the system supports keeping appropriate speed; i.e. neither going too slow nor too fast and maintaining a safe distance to other vehicles ahead.

Size of the problem

Inappropriate speed is an important contributing factor to PTW accidents.

Scientific Background

The impact of speed on accident likability is well documented, but no information is available to which extent ACC is capable of solving the problem for PTWs.

Expected impact

ACC has been introduced and broadly tested into the automotive domain, with controversial outcomes. The system is effective in keeping the speed within the preset threshold; on the other hand, it takes relevant part of the rider’s control on the vehicle, as speed helps keep the motorcycle standing in some critical conditions – therefore, if speed is automatically modified, it may ultimately impair riders’ safety.

ACC is an effective way to address the respect of safety distance, as it acts directly on the original issue, i.e. speed related to distance.

The aim of this measure is to provide riders with a tool that relieves them from the care of keeping the estimated safety distance. The final target, i.e., speed, is directly addressed.

Implementation

Riders’ rejection would be the strongest hindrance, as focus groups and interviews conducted within 2BESAFE framework suggest. Riders’ reactions aside, a special care should be given to training riders properly, so that they are able to handle motorcycles equipped with this kind of systems. Currently, implementation is driven by consumer demand.

Acceptance

Among all assistive systems, ACC received the lowest rating from riders in 2BESAFE's survey (see Deliverable D9, p60).

Sustainability

Too little is known about how riders would use ACC to provide an estimate on sustainability.

Transferability

Transfer depends on consumer demand.

Costs and benefits

ACC is available on a small number of relatively expensive vehicles. Costs could be determined by market prices, but there is no information available on benefits.

Riders' perspective

☆☆☆☆☆

The riders' associations strongly object to this measure because it significantly decreases rider safety: the throttle and brakes are essential to the steering and stability of a motorcycle, and the system's human-independent action on these controls jeopardizes the rider's ability to stay in control of her vehicle, potentially leading to falls and fatal accidents.

Priorities

ACC received lowest rating by both riders and experts.

Intelligent Speed Adaption

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	☆☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

Intelligent Speed Adaptation (ISA) is a technology which helps a driver to keep to the speed limit. The key to both systems is that the vehicle is aware of its location on the road and the speed limit at that location. It does this using a Global Positioning System (GPS) signal and a digital speed limit map which is held within the ISA unit. If the driver is exceeding the speed limit, the system can either warn the driver or intervene and automatically correct the vehicle's speed to conform with the speed limit.

Example:

In the project SAFERIDER, the Advanced Rider Assistance Systems incorporates amongst others the speed alert functionality. Thereby, information about legal speed will come from maps and focused with vehicle data. Development of this function is related to integration among OBIS information and standard data vehicle, as speed.

http://www.saferider-eu.org/aras.html

As part of the ISA project, a motorcycle trial was carried out in the UK. Two forms of ISA, one with an additional variant, were implemented on the motorcycle. Riders were given the opportunity to compare one with another so that the researchers could compare rider attitudes to and behaviour with the alternatives. The systems implemented were an Advisory ISA and an Assisting ISA; the variant was an Information ISA.

The Advisory ISA provided the rider with the current speed limit via an LED display and used flashing LEDs to alert the rider when the motorcycle was slightly above the speed limit. At the same time there was a beeping audio alert in the rider's helmet and vibration pulses in the saddle.

The Assisting System provided the rider with the current speed limit and used a counter-action on the throttle, which was not strong enough however to prevent the rider from keeping the throttle open. When the Assisting system was active, there was a sequential process in which first warning would be issued and then, if the vehicle continues to significantly exceed the speed limit, the throttle intervention would be applied.

The Information System provided the riders with travel information (e.g. upcoming traffic lights and junctions) in addition to all functionality that an Advisory ISA System offered. This configuration was designed to investigate whether combining ISA with other rider assistance systems led to a difference in riders' behaviour and acceptance of the ISA System.

The probands found the Advisory version to be the most positive in terms of usefulness, but were generally less positive about satisfaction with all versions of the system with negative satisfaction expressed for the Assisting ISA. It was also thought by the participating riders to be most suitable for young riders, novices and speed offenders. Riders were least likely to be willing to install the Assisting ISA. In terms of observed behaviour the Assisting ISA was the most effective in reducing speeding, particularly in the case of aggressive riders. This is in line with results obtained in various trials using ISA for passenger cars.

http://www.dft.gov.uk/pgr/roads/vehicles/intelligentspeedadaptation/motorcycletrial.pdf

Beneficiaries:

The technology is of interest because of the known relationship between speed and risk of an accident and also because of the relationship between speed and injury severity in an accident. Hence, ISA systems might reduce the number of accidents respectively the injury severity.

Clear definition of the problem

Speed is a major contributing factor to accidents, in particular in terms of PTW accidents. Speed limit may be violated intentionally or due to inattention. ISA either supports or forces a user to obey the speed limit in place on the road she/he is using.

Size of the problem

From ERSO (European Road Safety Obervatiory): In around 30% of the fatal accidents speed is an essential contributory factor. Firstly, speed affects the risk of being involved in an accident. At a higher speed, it is more difficult to react in time and prevent an accident. Secondly, speed affects the injury consequences of an accident. At a higher (impact) speed, more energy is released when colliding with another vehicle, road user or obstacle.

Speed is certainly a factor in several accidents involving motorcycles, e.g. falls due to excessive speed before a curve whose geometry requires a lower speed. This does not necessarily involve the legal speed limit.

Scientific Background, Expected impact

ISA has been introduced and broadly tested into the automotive domain, with controversial outcomes: The system is effective in keeping the speed within legal limits. For PTW, particular problems occur with ISA; other than exclusively informative systems take relevant parts of the rider’s control on the vehicle, as speed helps keep the motorcycle standing in some critical conditions – therefore, if speed is automatically imposed, it may ultimately impair riders’ safety.

ETSC, 2006: The safety effects that current ISA technology can deliver are already impressive. Research has shown that advisory ISA can achieve an 18% reduction, and non-overridable intervening ISA a 37% reduction in fatal accidents in the UK (Carsten and Tate, 2001). In other EU countries, up to 50% of traffic deaths could be avoided if all cars were equipped with supportive ISA (Carsten, 2005).

Implementation

ISA would have to be installed in all vehicles, in may be considered unlikely that riders purchase such a device on a voluntary basis. The system would have to be mature, i.e. it would have to consider the riding style of a particular rider. Fully accurate information is needed about speed limit on each road. As a particular issue for PTW, the intervention by the system would have to be done very carefully in order not to create additional dangerous situations e.g. during cornering.

Riders’ rejection would be the strongest hindrance, as focus groups and interviews conducted within 2BESAFE framework suggest.

Riders’ reactions aside, a special care should be given to training riders properly, so that they are able to handle motorcycles equipped with this kind of systems.

Acceptance

This measure will be more easily accepted by lawmakers and policy bodies, but boldly rejected by riders and related categories of people.

Sustainability

As long as the system is working properly, the effect is 100% sustainable. ISA systems implemented on a mandatory basis could be manipulated, as experience for speed limiters in trucks shows.

Transferability

Implementation requires accurate information on speed limits on all roads. This information has to be

Costs and benefits (ETSC, 2005)

Research has found that gains substantially outweigh the costs of ISA implementation. The benefit-to-cost rates predicted for six EU countries range from 2:1 to 4.8:1, taken into account a period of 45 years from 2005 to 2050. But this depends on the implementation scenario (Carsten, 2005).

If each country first encourages the use of supportive ISA and then mandates it for the remaining 10% of the car fleet (authority-driven scenario, 100% penetration by 2035), benefit-to-cost rates of up to 4.8:1 can be expected, depending on the country.

If only those who want ISA install it in their cars (market-led scenario, 40-60% penetration by 2015), the benefit-to-cost ratio will still range from 2:1 to 3.5:1, depending on the country.

In these calculations the cost of setting up and maintaining the speed limit databases has been included. This cost will be high at the beginning and will then decrease. Also the costs for the technology itself will go down over time. Current costs result from relatively low production levels. High volume production runs of the technologies that are needed for widespread application will result in economies of scale and thus unit cost reductions.

The predicted benefits from ISA result mainly from reducing death and injuries from road crashes. What has however not been taken into account is that ISA will also reduce the need for traditional police enforcement of speed limits and replace costly physical measures currently used to obtain speed compliance. ISA is much cheaper than any other means to enforce existing speed limits.

Riders' perspective

★★★★★

The riders' associations strongly object to this measure because it significantly increases the risk of accident: the throttle and brakes are essential to the steering and stability of a motorcycle, and the system's human-independent action on these controls jeopardizes the rider's ability to stay in control of her vehicle, potentially leading to falls and fatal accidents.

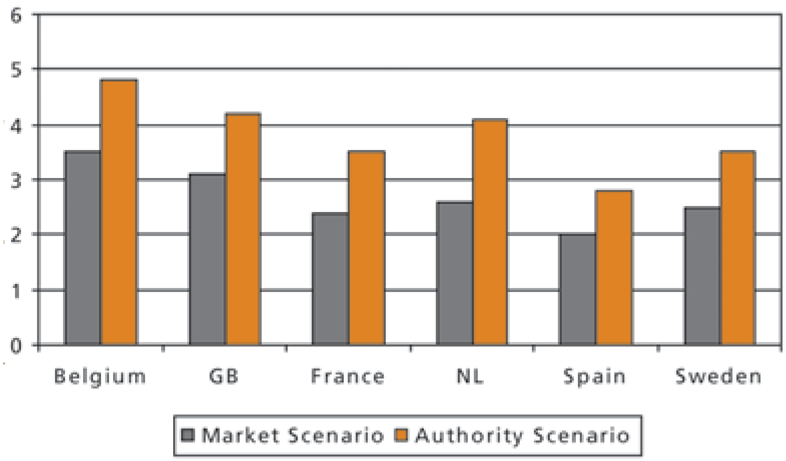

Figure 42: Benefit-to-cost ratios by country and scenario, Carsten 2005.

Priority

Intelligent Speed Adaptation may be considered a very effective instrument if reducing speed and, hence, reduce accident counts and severity. The discussion about it is even more emotional for PTW than it is for cars. There are certain concerns that - in case of intervening ISA - ISA would create dangerous situations due to poor consideration of the particular needs of the complex PTW vehicle dynamics.

Alcohol Interlock Devices for PTWs

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	☆☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★☆☆☆☆

Usually, an ignition interlock device is a mechanism installed to a motor vehicle's dashboard. But such a device could also be fitted to motorcycles, so that they cannot be started if the motorcyclist's blood alcohol concentration is greater than the legal or any other applied limit. For example, the laws could permit the imposition of ignition interlock devices as sentencing alternatives for drunken drivers.

Example:

The European Commission has supported a comprehensive study on implementation of Breath Alcohol Ignition Interlock Devices (BAIIDs).

http://ec.europa.eu/transport/road_safety/projects/doc/alcolock.pdf

Bax et al (2001, p3):"Over the last 15 years several American and Canadian BAIID programmes for DUI (driving under the influence) offenders have been evaluated. Despite huge differences among the programmes, the target groups and the accompanying evaluation studies, study results indicate that BAIIDs effectively prevent drink-driving during the period of BAIID installation.

Most studies, however, give proof of methodological inadequacies which make the results less conclusive. In only one study, in Maryland, multiple DUI offenders were randomly assigned to the experimental or the control group. Preliminary results indicated that, within the first year of BAIID programme participation, DUI recidivism was reduced by about 65% (Beck et al., 1999).

According to most studies, after BAIID removal from the vehicle recidivism rates appeared to increase again. No residual effect in preventing impaired driving could be observed. An exception is preliminary data from a BAIID programme in Quebec, which started in 1997. The study design was that of a before-during-after comparison. No control group was included in the study. During the period of BAIID installation, the DUI recidivism rate dropped by more than 90%. In a six-month period following removal of the BAIID, the recidivism rate did not increase. Furthermore, traffic offence and crash figures showed a significant decrease during both the BAIID- and after-periods (Dussault & Gendreau, 2000).

Preliminary results from a study in Calgary and Edmonton (Alberta, Canada) suggest that the incorporation of rehabilitation ('harm-reducing intervention') in the BAIID programme has positive effects on recidivism rates after the BAIID period. This finding, however, was not statistically significant. The rehabilitation programme was designed to educate and raise awareness among participants of the need to plan and re-evaluate their vehicle use whenever alcohol consumption was likely to occur. The participants met with a case manager every time the BAIID needed servicing.

Furthermore, statistical analysis showed that programme participants with high failure rates during the BAIID period were 2-3 times more likely to commit a re-offence after the BAIID period. This result suggests that participants with high failure rates should be required to have an interlock for an extended period (Marques et al., 2000)".

Eksler & Janitzek, 2010: "Between 1999 and 2002 the Swedish Road Administration began a national large scale trial with three companies and almost 300 alcohol interlocks: a taxi firm, a bus company and a truck company. Several manufacturers are now offering the installation of alcohol interlocks in trucks as a dealership option. .... From 2007, all trucks of 2.5 tons and over which are contracted by the SRA for more than 100 hours per year have to be fitted with alcohol interlocks and this requirement is already part of the procurement criteria. Additionally, all cars rented for more than six months must be equipped with an alcohol interlock. There are now an estimated 60,000 alcohol interlocks in use in the commercial context in Sweden. This is in a total fleet number of approximately

200,000 commercial vehicles (heavy good vehicles, buses, taxis and some light trucks and company cars)."

Figure 43: Dräger Interlock® XT Breath Alcohol Controlled Vehicle Immobilizer

Beneficiaries:

An ignition interlock device can effectively prevent alcohol accidents, which practically means that they protect a majority of road users against the minority of drunk drivers as well as drunk drivers before themselves.

Clear definition of the problem

The only goal of alcolock devices is to prevent drink-driving.

Alcolock devices are currently mainly applied to particular target groups. The ALCOLOCK trial, as an example, included four groups: Norwegian and Spanish bus drivers, German truck drivers and Belgian drink driving offenders and alcohol dependent patients.

Size of the problem, Costs and benefits

From ERSO (European Road Safety Observatory): About 25% of all road fatalities in Europe are alcohol related whereas about only 1% of all kilometres driven in Europe are driven by drivers with 0.5 g/l alcohol in their blood or more. As the Blood Alcohol Concentration (BAC) in the driver increases, the crash rate also rises. The increase in crash rate that goes with increasing BAC is progressive. Compared to a sober driver the crash rate of a driver with a BAC of 0.8 g/l (still the legal limit in 3 of 25 EU-member states) is 2.7 times that of sober drivers. When a driver has a BAC of 1.5 g/l his crash rate is 22 times that of a sober driver. Not only the crash rate grows rapidly with increasing BAC, the crash also becomes more severe. With a BAC of 1.5 g/l the crash rate for fatal crashes is about 200 times that of sober drivers.

According to Mohan (2006), between 20 and 30 percent of fatally injured drivers in many high-income countries have illegal blood alcohol concentrations (BACs), with this figure being between 33 and 69 percent in low-income nations.

Driving under the influence of alcohol (widely abbreviated by "DUI", consequently riding under the influence of alcohol has to be "RUI"), however is not expected to be a problem of comparable size for PTW, as indicated in Figure 44.

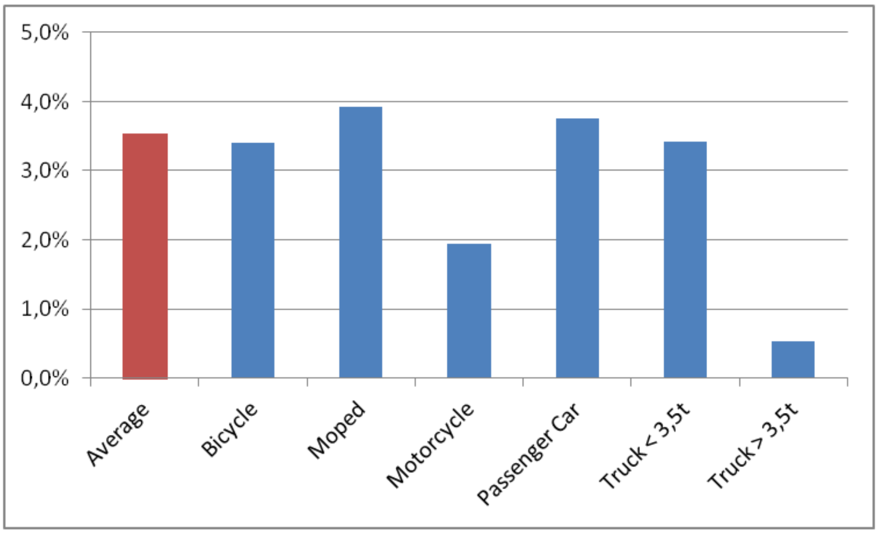

Figure 44: Injury accidents, Austria, 2008-2010: Drivers & Riders detected DUI above legal limit

Eksler & Janitzek, 2010: "The consequences of harmful and hazardous alcohol consumption include, amongst others, a considerable number of deaths on EU roads. Driving whilst under the influence of alcohol contributes annually to around 10,000 deaths on EU roads. In the EU as a whole, at least 1% of journeys are associated with an illegal Blood Alcohol Content (BAC) (ESCAPE 2003, ETSC 2003). National data show that typically 15-25% of deaths are associated with alcohol impairment of an active accident participant. If the number of alcohol impaired drivers had dropped to zero, some 6,800 lives could have been saved in 2007, representing some 16% of the total number of deaths. Among all road deaths, those related to alcohol are most regrettable, as they arise from a well known risk behaviour. Based on the above figures and assuming the average social costs per death at €1.5 million in the EU, the costs of drink-driving could be estimated at €12 billion. This practically equals fiscal revenues generated through the alcohol trade. Therefore tackling drink-driving is economically vital."

Scientific Background

Eksler & Janitzek, 2010: "Alcohol is easily absorbed in the bloodstream and has direct effects on the central nervous system brain, spinal cord and the nerves originating from it). In the first place alcohol depresses the central nervous system. This is to say that after having consumed low quantities of alcohol, social inhibition starts to become less stringent and one begins to act and feel more emotional. However, cognitive, visual, and motor functions also begin to deteriorate after small quantities of alcohol have been consumed. Even with a BAC as low as 0.3 g/l, most people can divide their attention less adequately and are less vigilant than without alcohol. With the BAC just above 0.5 g/l, most people also start to get perception problems; start to perform less well on cognitive tasks and tracking tasks. Also reaction times become longer. Motor impairment can be observed in most people with a BAC of 1.5 g/l and higher (Koelega 1995)."

SARTRE 4, the 4th edition of a large scale European opinion poll on attitudes towards road safety has, for the first time, included PTW riders as a target group.Questions on attitudes towards drunk driving were ask both todrivers and riders.

Expected impact, Sustainability

Please, see above, "Example"!

Implementation, Acceptance, Transferability

Silverans et al, 2006: "From these interviews, and from the data recorded by the alcolocks, it appeared that alcolocks are relatively practicable in both commercial and non-commercial contexts. Using the device did not interfere significantly with the drivers' tasks and was generally evaluated as easy. The general acceptance of the alcolocks was good and remained high throughout the entire twelve-month period. In the commercial trials relatively few positive breath tests were recorded, whereas half of the offenders in the non-commercial trial recorded ten or more failed breath tests. The fact that almost no failed breath tests occurred while driving in the offender subgroup, illustrates a clear behavioural impact of the alcolock. From the interviews with the commercial drivers, it appeared that the truck drivers' clients reacted rather indifferently, whereas bus passengers had a positive attitude towards the devices. This confirmed the hypothesis that alcolocks may be marketed as an element of quality improvement. All together, the results showed that it is feasible to implement alcolocks in different commercial and non-commercial contexts, on the condition that the introduction of the devices, the inclusion process and the monitoring procedures are carefully prepared."

Riders' perspective

★★★★★

The riders' associations strongly object to the large-scale installation of "alcolocks", because it unnecessarily restricts the user's freedom of movement, amounts to treating the vast majority of law-abiding users as criminals, and due to the costs of installation and integration would not be cost-effective at all.

Priorities

Although there is overwhelming scientific evidence on the usefulness of alcolocks, the expert rating are very low. This may be due to the fact that experts considered DUI not being a problem with PTW riders, which is according to the evidence from Austria true for motorcycles but not for mopeds.

7.5. Other Technical Specifications

Rear-view Mirrors

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★☆☆☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★★☆	Sustainability	★★★★★

Rear-view mirrors aim at guaranteeing a clear view towards the rear of the vehicle. The directive regulates the dimensions and radius of curvature of the reflective surface, the design, the shape or materials used. It also regulates their attachment to the vehicle.

Examples:

The issue of rear-view-mirrors is regulated in the directive 97/24/EC of the European Parliament and of the Council of 17 June 1997 on certain components and characteristics of two or three-wheel motor vehicles. It was implemented in 1997 and the process of implementation consisted of a single incident of strong public interest, publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. Now it is law of the Member States of the European Union.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

Beneficiaries:

As mirrors are an important safety device, all PTW riders benefit from it as it aims at reducing PTW accident numbers.

Figure 45: Rear view mirrors

Clear definition of the problem

In order to perform manoeuvres in a safely manner or even avoid a rear-end accident, the view of the road environment upstream is essential. This is even more important as PTWs are vulnerable road users and have completely different kinetic characteristics from the other road users.

Size of the problem

Riders now being aware of the traffic that is in the rear cannot perform safely manoeuvres. In addition, some riders might turn back to look before making a manoeuvred, which is also risky if there is a potential conflict in front of them that requires immediate action.

Scientific Background

Scientific evidence addressing the need for rear view mirrors on PTWs.

Implementation

PTW have to be fitted with two rear view mirrors in the EU. Implementation elsewhere might be an issue of a legal obligation as well, which can easily be implemented.

Expected Impact(s)

It may be easily be assumed that this measure increases both PTW safety and mobility. Rear view mirrors have an effect on various types of accidents, certain manoeuvres can hardly be executed without, like lane changes or overtaking. Considering that fact that rear view mirrors have been fitted to motorised vehicles from the very beginning of their existence, determination of an impact would have to be done based on the question what would happen without them.

Acceptance

The measure is accepted by the majority of riders, however there is a small proportion that takes the mirrors out in order to have a smaller width and make manoeuvres (splitting) in traffic at least in Greece.

The measure is already accepted by all relevant groups.

Riders that take off their rear-view mirrors are aware of the risk, but their mentality “this will not happen to me” and their desire for shorter travelling times affect their decision.

Sustainability

As indicated above, sustainability may suffer from illegal dismounting of mirrors or road users failing to use them properly.

Transferability

This measure can be implemented anywhere.

Costs and benefits

No data available according to our knowledge with respect to PTWs.

Riders' perspective

★★★☆☆

The riders' associations support the installation of rear view mirrors, as requested by type-approval rules today.

Priorities

For trucks and busses, additional mirror have recently been subject to a new law on mandatory retrofitting, which may give an indication on importance of the issue, even if reasons for equipping busses, trucks and PTWs with rear view mirrors can hardly be compared.

Specifications of Tires and Wheels

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★★★★
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★★

The measure contains administrative provisions for the component type approval of tires, definitions, markings and requirements concerning tires and requirements for vehicles with regard to fitting of their tires.

Example:

Specifications of tires are defined in Directive 97/24/EC the European Parliament and of the Council of 17 June 1997 on certain components and characteristics of two or three-wheel motor vehicles. The guideline was implemented in 1997 and consisted of a single incident of strong public interest, publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. By now it is law of the member states of the European Union.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

Beneficiaries:

The correct status of tires is crucial for the safety of all PTW riders. For this reason, the measure is beneficial for PTW riders. Furthermore, it is beneficial for other road users as they can be involved in an accident with a PTW rider, who lost control over his vehicle.

Figure 46: Motorcycle wheel[38]

Clear definition of the problem

The usage of the wrong tires on the PTW (not specified for the PTW, no type approval) can cause risky vehicle dynamics. Another major cause of crash risk is the underestimated influence of the tire pressure on vehicle manoeuvres. The specifications regarding the appropriate pressure must be communicated more redundant.

Size of the problem

PTW riders (especially racing riders) know the influence of suitable tires (with correct pressure). The potential PTW accident risk needs to be investigated.

(Scientific) Background

The best background for that measure are industrial (tire manufacturer) standards and production guidelines. Knowledge of very experienced test riders or racing riders published in several books explain the need of that measure.

Implementation

There no barriers to implementation, just the PTW riders should be more aware about the tire/wheel issues.

In the last years it was common practice of the industry to optimize and specify tires for single PTW models (e.g. Supersport bikes); those tires are mostly specified to bring the enormous horsepower of the PTW on the ground. Those special developed tires are really dangerous when having the incorrect tire pressure or rubber temperature.

In driving schools and in PTW stores the importance of the tire-road-safety influences must be communicated

Expected Impact(s)

Standards for tires and rims are a necessary precondition for competition on the market. Standards may include minimum safety requirements for tires and rims. It may be assumed that such standards are a condition for vehicle design and development; as well as they are an issue of consumer protection. Accidents resulting from technical failure of tires and/or rims and resulting from use of tires and rims not suitable to a vehicle can be widely avoided.

Acceptance

Standards are normally developed by initiative of the industry. It may be assumed that the individual road user appreciates minimum safety standards of products on the market.

[38] Source: http://www.overlandtoindia.co.uk/page5.htm, 31 Jul. 2009

Sustainability

The specification procedures need to be updated regularly (state-of- the-art)

The best specifications will not help, if riders ignore the importance of appropriate tires

Transferability

Tire standards currently used in the EU are prepared a working group under the umbrella of the United Nations, these standards can be adopted anywhere.

Costs and benefits

No figures could be found, available studies focus on minimum tread depth of tires in use. Evidence is available on use of studded tires, but no study could be found focussing on the existence of standards for tires.

Riders' perspective

★★★☆☆

The riders' associations support this measure because it provides customers with reliable information about products offered for sale.

Priorities

Standards for tires are a matter of course in the highly industrialised countries and should also be anywhere else.

Method of Measuring Tire Rolling Circumference for New Tires under Loaded Conditions

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★★★★

This measure contains the method to measure tire rolling circumference for new tires under loaded conditions. A special section deals especially with motorcycle tires.

Example:

The described measure results from a study conducted by the German Federal Highway Research Institute, which itself is the result of the work of a technical working group. From this work resulted the national guideline “BS AU 50-1.6.8 – DIN” which was implemented in 2002.

Beneficiaries:

The correct status of tires is crucial for the safety of all PTW riders. For this reason, the measure is beneficial for PTW riders. Furthermore, it is beneficial for other road users as they can be involved in an accident with a PTW rider, who lost control over his vehicle.

Clear definition of the problem

Information about the effective circumference of tires is necessary to assure adequate performance of a number of vehicle systems, e.g. speedometer and ABS.

Size of the problem

Such information cannot be provided in quantitative terms. However, riders rely on informative and safety systems of their vehicles. Accurate speed information is a condition to comply with speed limits. ABS and other systems require accurate information about speed. Speed information is hardly collected directly. Most systems measure rotational speed of the wheel and multiply by an expected value for the effecting rolling radius. Hence, a standardized procedure for measuring the effective radius or circumference is required.

Scientific Background

See above.

Expected impact

A reliable procedure for measuring the effective tire circumference should facilitate the accurate function of a number of vehicle (safety) systems.

Implementation

Inside the EU, a respective standard is implemented. This or other standards can easily be implemented.

Acceptance

Resistance can only be expected where the implementation of a standard requires replacement of procedures already applied.

Sustainability

Impacts can be expected to be permanent.

Transferability

Since the PTW market is a global one, technical standards are highly transferable.

Costs and benefits

No cost-benefit analysis could be found.

Riders' perspective

★★★☆☆

The riders' associations support this measure because it provides customers with reliable information about products offered for sale.

Priorities

Countries not having a standard for measurement of effective tire circumference should urgently implement a harmonized procedure.

Trailer Coupling Devices

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★★☆
Safety impact	☆☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★☆☆☆

The measure establishes definitions for the dimensions, the positioning as well as requirements for articulation and strength of trailer coupling devices. Furthermore, safety and handling requirements are fixed by this measure. The measure also contains test methods for coupling devices.

Example:

The use of coupling devices is regulated in the transnational directive 97/24/EC of the European Parliament and of the Council which was implemented in 1997. The process of implementation consisted of a single incident of strong public interest, publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. Now it is law of the member states of the European Union.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

Beneficiaries:

The guideline addresses the vehicle categories motorcycle and moped and is targeted on technical requirements.

Figure 47: Trailer[39]

Clear definition of the problem

Legal provisions for the type-approval and use of trailers varies from country to country. The absence of a clear legal framework hampers the safe use of trailers.

Size of the problem

In Europe, the requirements for the type-approval of motorcycle trailers are regulated in directive 97/24/EC. However, the directive clearly states that Member States remain free to allow or not the use and registration of trailers on their territory. In Europe, Italy and Ireland ban the registration of trailers on safety grounds, a policy backed by the Court of Justice of the European Communities in decision C-110/05, Commission vs. Italian Republic40.

In some countries where trailers are allowed, their use is curtailed in practice because of the reluctance of motorcycle manufacturers to provide the maximum towable weight on their models, data that is required to proceed with the EU type-approval of the motorcycle and trailer combination. This is the case for example in Sweden.

Scientific Background

Swedish motorcyclists' association SMC ran performance tests in May 2010, in the presence of officials from the Swedish Transport Agency and representatives from the motorcycle and towing equipment industries. The test involved two motorcycles, one with ABS, one without, comparing braking distances at 50km/h with and without a trailer of a mass of 142kg. The results were the following:

- Motorcycle without ABS, without trailer: Braking distance 9,40 meter
- Motorcycle without ABS and with trailer Braking distance 10,30 meter
- Motorcycle with ABS and without trailer: Braking distance 5,80 meter
- Motorcycle with ABS and with: Braking distance 6,60meter

In all cases the brake performance was well within the requirements of the Swedish roadworthiness test for motorcycles.

Accident data from Sweden show that the trailers do not incur a higher accident risk. Out of 5 300 motorcycle accidents during the 2007-2009 period, none involved a motorcycle towing a trailer. This data is corroborated by insurance companies in Sweden contacted by SMC.

[39] Source: http://www.robertawhite.com/piggybacker.htm, 31 Jul. 2009

[40] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62005J0110:EN:HTML

Expected impact

Clearer legislation for the type-approval and registration of trailers will be beneficial for users, ensuring safe use, increasing mobility, including mobility across Europe.

Implementation

A new EU regulation on the type-approval of two- and three-wheelers, being discussed at the European Parliament as of July 2011, could have the potential to provide a clearer framework for users, authorities and the industry.

Several options are available. The maximum towable weight can be given by the towing coupler manufacturer. The requirement for the maximum towable weight can be removed. A simple option would be for motorcycle manufacturers to voluntarily publish information about the maximum towable weight of their models.

Barriers to the implementation of these measures include the reluctance of legislative bodies to provide the appropriate legal framework, or of the industry to provide the towing weight data.

Acceptance

Acceptance can be hampered by a perception that the users of motorcycle trailers are a small minority of the population and do not warrant the efforts needed to improve their situation. Increasing awareness can be done by underlining that the freedom of movement, and in Europe, the free movement of goods, should not suffer exceptions for minorities.

Sustainability

An adapted legal framework can stay in place once implemented, and would have to be carried on in later evolutions of traffic law and type-approval legislation.

Good practice from the industry, in the form of providing the information on the maximum towable weight of models, must be continued on new models for the measure to be effective.

Transferability

Transferability in Europe is high.

Transferability to other countries can occur through the use of European technical regulations for type-approval.

Costs and benefits

Costs for the industry and the public are low. Users can expect lower costs for the purchase and use of trailers thanks to a clearer, more effective registration process.

Riders' perspective

★★★★☆

The riders' associations strongly support this measure because it provides customers with reliable information about trailer use and configurations, and allows trailer owners to safely travel across Europe without the hassle of dealing with different rules and regulations in different countries.

Priorities

Standardisation of trailer couplings has advantages, as indicated above. However, the number of motorcycle trailers is very low, there is a minor problem, and hence, no significant priority.

Stands for Two Wheel Motor Vehicles

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★★☆
Total impact	☆☆☆☆☆	Implementation	★★★★★
Safety impact	☆☆☆☆☆	Acceptance	★★★★☆
Efficiency	☆☆☆☆☆	Sustainability	★★★★☆

All two-wheel vehicles shall be fitted with at least one stand in order to keep them steady when stationary (e.g. when parked) but not held in a static position by a person or external means. Twin-wheel vehicles are not in need of stands but must meet the requirements of the Directive (set out in 6.2.2) when placing them in a parking position (parking brake applied).

Example:

The regulations for stands of PTWs are defined in the directive 93/31/EEC (Stands for two-wheel motor vehicles). The directive was implemented in 1993 and the process of implementation consisted of a single incident of strong public interest, publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. Now it is law of the member states of the European Union.

The safety problem is with prop stands. If a prop stand is not properly moved into travelling position, the rider is likely to fall in the very first corner.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0031:en:NOT

Beneficiaries:

The guideline addresses the vehicle categories motorcycle and moped and is targeted on technical requirements.

Figure 48: Parked motorcycle with stand[41]

Clear definition of the problem

Prop stands have to be designed to avoid dangerous events by either

- move into driving position automatically, if the vehicle is taken off the stand
- mounting a soft device to the stand, which touches the road surface beforehand and moves the stand into driving position
- ignition interlock with stand not in driving position.

Size of the problem, Scientific Background, Expected impact, Costs and benefits

No evidence could be found addressing these issues.

[41] Source: http://www.njbikeinsurance.com/images/parkedbike.jpg, 29 Aug.2010

Implementation, Transferability

Vehicle manufacturers will have a strong interest to avoid accidents caused by stands in parking position. A stand without protective measures against such accidents could be considered a built-in error. European legislation may serve as a model and can be implemented anywhere.

Acceptance

It is unlikely that anyone would interfere with the measure, even if it is implemented on a mandatory basis.

Sustainability

Neither fading nor compensatory effects are likely to occur.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it provides customers with reliable information about products offered for sale.

Priorities

Experts rank the measure very low in terms of problem an impact. This may be due to respective legislation being in place for decades and manufactures using safe stands to their own interest. By common sense, this measure can be considered inevitable.

External Audible Warning Devices

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★☆☆
Total impact	★☆☆☆☆	Implementation	★★☆☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

Two- or three-wheel motor vehicles must feature an audible warning device to warn by an acoustic signal in case of dangerous road traffic situations. The device must be audible for all road users, but it must not be too loud because people could be exposed to the danger of hearing damage.

Example:

The Council Directive 93/30/EEC on audible warning devices for two- or three-wheel motor vehicles sets the sound level, the sound characteristics and the sound spectrum as well as the methods how to test these requirements.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0030:en:NOT

Beneficiaries:

It is necessary to draw up harmonized requirements concerning audible warning devices for two- or three-wheel motor vehicles in order to enable the type-approval and component type-approval procedures laid down in Directive 92/61/EEC to be applied for each type of such vehicle.

Clear definition of the problem

External audible warning devices are an element of communication of road users in case of emergency aiming at a last-second change of other road users' behaviour in such situations. They can also be used for various other communication purposes.

Priorities

It is considered rather futile commenting on the other issues like transferability, sustainablility, etc. Audible warning devices are present on all kinds of road vehicles worldwide, even if it is only the voice of a pedestrian or bicycle rider. They are considered necessary. If any priority has to be given, it should aim at defining a technical standard, which includes an upper and lower limit for volume to ensure effective warning not impeding health.

This statement does not address audible warning devices mounted on electric vehicles in oprder to compensate for the silent movement of these vehicles.

Internal Audible Warning Devices

This measure was not included in the expert survey.

Driver information by sound may be used, where information has to be provided independent from where the driver is looking at, if the information is particularly urgent or too complex to be provided by other means in order to reduce visual distraction.

Example:

There are variable applications: eCall (communication from operating centre to rider), navigation system, activation of turn light indicators, etc.

Beneficiaries:

It strongly depends what such devices are used for. Warnings may be given for the use of turn light indicators, warning on technical failures or other information purposes.

Clear definition of the problem

Audible warning devices assist the rider in cases he/she is in a position to receive information through a warning by the status of the chosen route. The rider then has the choice to rectify his/her riding behaviour accordingly.

Size of the problem

Similar systems have proven to be usable, efficient and assistive for passenger car drivers. Such assistive systems with audible modality have been commercialized. Such examples are the audible warnings in case of lane departure. Riders are very vulnerable road users and their behaviour on the road is a manifestation of increased complexity skills. As complexity increases in a situation, the possibility for a mistake, error or omission is also increased. Assistive audible devices could assist and protect the rider in dangerous situations, conflicts, injuries, and accidents.

Scientific Background

Audible warning devices developed within the European project SAFERIDER were evaluated by riders across several European countries and they were found to be of increased assistance when simple straight forward sounds or very short messages were given. In case of more complicated messages or combination with other types of messages (e.g. visual) a conflict could occur. The conflict was reported to be lower or not a conflict at all in cases was the audible warning was accompanied by a haptic one.

Implementation

Warnings are helpful as an idea. However, their interference with riding experience is still to be investigated further. Distraction because of assistive devices has been the focus for automotive industry and researchers alike. Cognitive workload due to auditory signals and their interference with visual input and cognitive processing of the situation should be taken into serious consideration and further testing is required.

Expected Impact(s)

It is anticipated the measure will impact safety and efficiency. If the rider makes fewer mistakes then the possibility is to have more harmonious traffic flow and a more efficient network. The best practice account would be to evaluate the long term effect on certain conditions and related riding scenarios identified as dangerous. Risk compensation is a possible negative aftermath. Riders might become risky as they would over-rely on audible assistance.

Acceptance

Acceptance by riders is difficult to be estimated. It is possible certain riders (leisure riders mostly) to find audible devices annoying or interfering too much with riding experience. However, novice riders might welcome audible warnings more. Therefore, acceptance for this measure might benefit more from stratification by rider group. Industry and infrastructure would probably have to collaborate closely for the deployment of such devices and will accept them as highly useful. The same could hold true for the trainers, educators and legislators.

Sustainability

Fading effect might appear due to risk compensation and towards the discovery of other risk prone behaviours. Therefore, training is essential for the successful implementation of such measures in order to avoid also overwhelming implementation of these types of devices.

Transferability

The implementation is possible on national, European, and international level. As audible warnings carry a universal significance is not difficult to see their easy application.

Costs and benefits

The application might be easy due to high comprehensibility, however, the related costs will be high involving mainly the industry and secondary the educators, trainers, and OEMs. The anticipated benefits will be high. There is a possibility that initial costs will be higher than firstly come benefits but within the first five years of implementation, the benefits will appear.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

Audible warning devices are at the cutting edge of ICT related applications to PTWs and gaining knowledge from relevant systems in passenger cars, therefore a relatively high priority should be given.

Standardized Speedometers

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★★☆
Safety impact	★☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★☆☆☆

Speedometers are the most important control instruments for PTW riders. They can check if their speed is in accordance with the speed limits and get a better sense for speed.

Example:

The Directive 2000/7/EC on speedometers for two- or three-wheel motor vehicles and amending Council Directive 92/61/EEC on the type-approval of two- or three-wheel motor vehicles sets the technical requirements for speedometers: The dial of the speedometer must be located within the direct field of view of the driver and must be clearly legible during day and night. The range of speeds displayed must be sufficiently wide to include the maximum speed of this type of vehicle as stated by its manufacturer. This Directive was implemented in 2000.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0007:en:NOT

Beneficiaries:

It is necessary to draw up harmonized requirements concerning speedometers for two- or three-wheel motor vehicles in order to enable the type-approval and component type-approval procedures laid down in Directive 92/61/EEC to be applied for each type of such vehicle.

Figure 49: Speedometer[42]

Clear definition of the problem

Recognition of speed on a speedometer is a highly automated task of drivers and riders. In order to minimise duration of detection and distraction from the driving environment, recognisability shall receive high attention. Variation of modes and design of devices may result in wrong or delayed detection.

Size of the problem

On an average, it takes a driver 1.1 seconds to check his speed by looking at the speedometer, for digital speedometers it is slightly longer. For this period, the driver's attention is off the road ahead. Uniform design of speedometers shall ensure that these periods do not extend if drivers/riders change from one vehicle to another.

Scientific Background

Design factors are proven to influence the speedometer reading. In particular, digit size, speedometer position, contrast and background colour (Boreczky J. et al, 1988).

Because standardization enhances timely recognition and reduces error factors caused by a prior experience influencing the interpretation of data by riders.

It targets in particular speed recognition but cannot prevent speeding deriving from other factors (e.g. sensation seeking).

Implementation

PTW manufacturers have their own standard and ‘traditions’ in designing speedometers, for some of them even constituting a trademark. This directly leads to riders, used to a certain manufacturers, not accepting the change.

That standardization occurs on good, validated models, as it is a good contributing factor but it is not the only factor that helps riders in quick speed recognition.

Expected Impact(s)

Standards on speed displays aim at minimising the time needed by riders to check their actual driving speed.

[42] Source: http://ibikeinsurance.com/pictures/kawasaki/kawasaki-speedometer.htm, 13 Aug. 2009

Acceptance

As indicated above, standardisation of speed displays in principle is well accepted. It mainly concerns manufacturers and OEMs. Corporate design may be an issue affecting the willingness of vehicle and original equipment manufacturers to change their usual way of displaying speed information.

Sustainability

Side effects can hardly be expected. Better display of speed information will hardly motivate any rider to rider faster. A certain risk may be expected in individualisation of vehicles, where riders could replace original equipment by after-market products.

Transferability

Such standards can be applied anywhere.

Costs and benefits

No information could be found.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

There is a clear and well accepted need for standardised display of speed information. Where such standards are not in place, they should be implemented urgently. The low ratings by experts may be based on the fact that such standards are in place in the EU for decades and changes are not considered necessary.

Standardized Symbols on Controls, Telltales and Indicators

Expert Assessment			
Overall		★★☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★★☆
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	★★★☆☆	Sustainability	★★★★☆

Controls, telltales and indicators are important action and information tools for PTW riders. “Control” means any part of the vehicle or component directly actuated by the driver which causes a change in the state or operation of the vehicle or one of the parts thereof; “telltale” means a signal indicating the triggering of a device, an operation or a suspect or faulty state or an absence of operation and “indicator” means a device providing information on the proper functioning or state of a system or part of a system such as the level of a fluid.

Recognition of vehicle-to-driver information is a highly automated task of drivers and riders. In order to minimise duration of detection and distraction from the driving environment, recognisability shall receive high attention. Variation of modes and design of devices may result in wrong or delayed detection.

Controls, telltales and indicators are important action and information tools for PTW riders. “Control” means any part of the vehicle or component directly actuated by the driver which causes a change in the state or operation of the vehicle or one of the parts thereof; “telltale” means a signal indicating the triggering of a device, an operation or a suspect or faulty state or an absence of operation and “indicator” means a device providing information on the proper functioning or state of a system or part of a system such as the level of a fluid.

Example:

The Council Directive 93/29/EEC on the identification of controls, tell-tales and indicators for two- or three-wheel motor vehicles sets the following standards:

- Symbols shall stand out clearly against the background
- Symbols shall be placed on the control or control telltale
- Placement of symbols
- Meaning of different colors

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0029:en:NOT

Beneficiaries:

It is necessary to draw up harmonized requirements concerning controls, telltales and indicators for two- or three-wheel motor vehicles in order to enable the type-approval and component type-approval procedures laid down in Directive 92/61/EEC to be applied for each type of such vehicle.

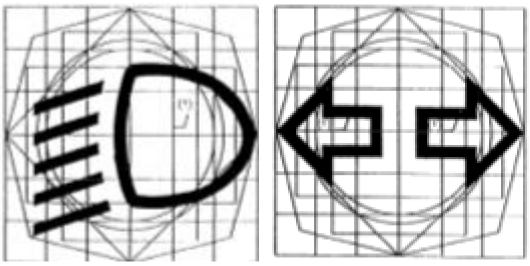

Figure 50: Specifications for symbols[43]

Clear definition of the problem

Difficulties in understanding on-board info when shifting from a vehicle to another.

Size of the problem, Scientific Background, Expected impact, Costs and benefits

The wrong interpretation of indicators and telltales may lead to improper or uninformed riding behaviour.

Standardisation enhances timely recognition and reduces error factors caused by a prior experience influencing the interpretation of data by riders. Standardisation imposes an interpretation by convention. This addresses the problem directly. However, there is no evidence about accidents being caused by differences of instruments and signs and no information on accident reduction potential.

Implementation, Acceptance, Transferability

To a certain extent, manufacturer might be reluctant to harmonise all signals, which may impair their corporate design. To a large extent, implementation will be driven by international standards.

Sustainability

Neither fading nor compensatory effects are likely to occur.

Riders' perspective

★★★★★

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

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[43] Source: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1993L0029:20001219:EN:PDF, 13 Aug. 2009

Priorities

There is no scientific evidence to support this measure. By common sense it seem logical that harmonised signals are beneficial if riders change from one vehicle to another. Considering that there is legislation in place, there seems to be no urgent need for action.

Steering Wheel Locks

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★★★
Safety impact	☆☆☆☆☆	Acceptance	★★★☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★☆☆☆

The principal function of steering wheel locks is to prevent motorcycle theft. They also prevent unauthorized usage of motorcycles by non-skilled people and therefore steering wheel locks are also a road traffic safety measure. Since 1993, PTWs have had to be equipped with a protective device that disables unauthorized people to point, drive or move the vehicle straight ahead.

Example:

The Council Directive 93/33/EEC on protective devices intended to prevent the unauthorized use of two- or three-wheel motor vehicles says that they must be such that it is necessary to disable the protective device in order to point, drive or move the vehicle straight ahead. The Directive, which was implemented in 1993, also sets other general and specific requirements as well as the methods how to test them.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0033:en:NOT

Beneficiaries:

It is necessary to draw up harmonized requirements concerning protective devices intended to prevent the unauthorized use of two- or three-wheel motor vehicles in order to enable the type-approval and component type-approval procedures laid down in Directive 92/61/EEC to be applied for each type of such vehicle.

Clear definition of the problem

This measure addresses PTW thefts as well as unauthorized usage of PTWs by non-skilled people.

Size of the problem

In the course of the European Crime and Safety Survey (EU ICS) conducted in 2005, approximately 0.3% of all interviewees reported that their PTW was stolen.[44]

Scientific Background

Every kind of protective device deters thieves from stealing PTWs. Besides, as long as the PTW owner holds the keys, unauthorized usage can nearly be excepted.

It is a basic protective device but does not guarantee complete security against thefts.

Expected impact

This measure will have an impact on security. Safety is only affected for the case that a crash occurs during unauthorised use.

[44] See: http://www.spiegel.de/panorama/justiz/0,1518,464778,00.html, 23.Nov.2011

Implementation

Implementation would be necessary at European level, either altering the respective Directives or, as soon as it is implemented, a new regulation on type approval, which possibly would mean that UN ECE standards would have to be adapted.

However, European legislation already includes mandatory steering wheel (steering bar) locks (Council Directive 93/33/EEC of 14 June 1993 on protective devices intended to prevent the unauthorized use of two- or three-wheel motor vehicles).

Acceptance

It is unlikely that PTW riders do not accept this measure as it secures their vehicle. As long as the installation of steering wheel looks is mandatory, the industry accepts this measure, too.

Sustainability

It may be considered unlikely that criminals do not compensate for any barrier to their "business". However, occasional unauthorised use of PTW will effectively and sustainably be avoided.

Transferability

New standards can be applied anywhere, however, it is know that many countries in the world do not have a comprehensive type approval process.

Costs and benefits

No data available.

Riders' perspective

★☆☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

Standards are implemented in the EU for decades, what may be considered the reason for rather low ratings. Wherever such standards are not in place, implementation on a mandatory basis should receive high attention.

8. Conspicuity and Lights

This section deals with a particular problem of PTW riding: Research has shown that a significant share in PTW accidents is due to a failure of other road users to either see or perceive a PTW rider or by misjudgment of approaching speed.

Hence, many countries implemented mandatory use of dipped beam headlight also during daytime (daytime running lights, DRL). But the main purpose of dipped beam headlights is to illuminate the road surface in front of the vehicle. It is a fact that they are not designed to make a vehicle visible to others.

Thus, optimizing perception of an approaching PTW by other road users is still a problem widely under discussion. The potential measures are of various kinds. Because of this, these measures would also fit in other categories. However, the importance of the issue advised to put all measures related to vehicle lights and their use into a separate chapter of this volume, regardless if they are behavioural, organizational or vehicle measures.

Mandatory Use of Headlights

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★☆

This measure is aimed at making the PTWV rider more visible to other traffic, and to help reduce "looked but failed to see" collisions in which another vehicle failed to perceive the presence of a PTWV in the roadway. The measure would increase the conspicuity of the PTWV by requiring the rider to use running headlights at all times. The conspicuity of PTW riders is a crucial element of their safety. As headlights enhance conspicuity, the mandatory use of headlights is a highly important measure for motorcycle safety.

Example:

The use of headlights is regulated for example in the Portuguese Highway Code, Highway Code revision - Decreto-lei n.º 44/2005 de 23 de Fevereiro (Guideline reference number: Decree-law number 44/2005, from 23th February). This national guideline was implemented in 2005 by the Ministry of Public Administration of Portugal.

http://www.prp.pt/informacao/actualidades/act_00107.asp

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider. According to the PROMISING project, the daytime use of headlights by motorcyclists gives a reduction in daytime car/PTW collisions of 30% to 40%.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.150

Figure 51: Motorcycle with headlights on (source: KFV)

Clear definition of the problem

PTWs are smaller and less prevalent than many other vehicles, and are often difficult to detect.

Size of the problem

In a 2-BE-SAFE laboratory experiment we found that car drivers are 10% less likely to enter junction when a conspicuous PTWV is present, relative to an inconspicuous PTWV.

Scientific Background

According to Underwood et al. (2011), car drivers are less likely to enter a junction if there is a conspicuous PTW (headlights on, high-visibility clothing) present, in comparison with equivalent situations in which an inconspicuous PTW (no headlights, dark clothing). Further results from simulator studies indicated that the odds of accepting a short time gap by car drivers to perform a turn manoeuvre in front of an approaching PTW are higher for PTW with headlight OFF than for PTW with headlight ON (Lenné, Mitsopoulos-Rubens, 2011, 2-BE-SAFE, Del. 18). Findings from interviews with pedestrians and motorists also suggest that headlight-use during daytime hours increases the conspicuity of motorcycles (Janoff & Cassel, 1971; Janoff, 1973). Using slides of traffic situations as stimuli, Hole and Tyrell (1995) found that observers detected motorcycles with DRLs more rapidly than unlit motorcycles. Headlight use during daytime hours has also been found to be effective on subjective conspicuity ratings (Motoki et al., 2007).

Expected impact

By increasing the PTW's visibility it is less likely that they will be involved in a collision. Drivers will be more cautious about entering the roadway occupied by the PTW. However, as other road vehicles increasingly use running lights during daytime driving, there will be a reduced impact of PTWs using lights to make themselves conspicuous.

Implementation

PTW riders are particularly resistant to being given instructions about how they should ride. When we described the results of the 2-BE-SAFE experiment to a UK weekly newspaper (MotorCycle News - MCN) their response was that collisions at junctions would be avoided if drivers were more careful. See MotorCycle News, 19 October 2011, page 11. The headline is "High-viz DOES improve safety". As another example of user resistance, see also page 7 of that issue of MCN in which a protest against prospective EU legislation preventing powertrain modifications, mandatory ABS, etc. The headline is "Join MCN protest: Help save biking from stifling EU measures". The protest took the form of a mass ride around Brussels, with banners, placards etc. Newspapers articles such as these raise awareness of safety measures, but they also indicate the resistance that will need to be faced.

Acceptance

See comments on "Implementation", above. Riders are resistant to legislation and argue that it is drivers who must change their own behaviour. They understand that high visibility works, but they feel that it is car drivers who should be educated.

Sustainability

Unknown. Research is required to answer these questions. We do know that risk compensation is a possibility - riders may take more risks if they believe themselves to be safer.

Transferability

Visibility depends upon ambient lighting, and so it is more important to increase visibility when riding when the light is poor, at dawn and at dusk. When riding in good daylight other measures need to be taken to increase driver awareness of PTWs.

Costs and benefits

The costs are minimal - the additional power required to ride with headlights is negligible. The benefits will range from zero to maximum, depending on whether failure to become visible results in a fatal accident.

Riders' perspective

★★★★★

The riders' associations object to this measure because it infringes on the freedom of road users. Safety-conscious riders already rely on their judgment to decide when their comfort and safety requires turning their headlights on.

Priorities

We know that increased visibility reduces the likelihood that a car driver will enter a junction occupied by a PTW. However, this is a result obtained in a laboratory, and before recommending any changes to legislation a field trial is necessary to establish that the decision-making of car drivers can be made more cautious on actual roads, when a high visibility PTW is present.

Type Approval of Lighting and Light-Signalling Devices

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

To ensure a general standard for lighting and light-signaling devices, type approval regulations are defined by the European Commission. This directive regulates the type approval concerning the function in regard to the type of the lamp. For enabling this, the directive defines to which measures the components of the lamps are tested as well as the methods for testing the components.

To ensure a general standard for lighting and light-signalling devices, type approval regulations are defined by the European Commission. As soon as the new regulation on the type approval of two and three-wheeled motor vehicles will come into effect, this regulation will be abrogated and there will be a reference to the respective ECE regulations instead of one regulation including single engineer standards.

Example:

Lighting and Light-Signaling Devices are regulated in the transnational directive 97/24/EC of the European Parliament and of the Council, which was implemented in 1997.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider.

Figure 52: Direction indicator[45]

Clear definition of the problem

- A significant share in PTW accidents is due to a failure of other road users to either see or perceive a PTW rider. Besides, several PTW collisions happen due to poor sight because the area is insufficiently illuminated by the lighting devices.
- According to recent research results (among which results from 2BESAFE) conspicuity can be improved by specific light design. However, to make use of these findings, light configuration needs to be harmonized as far as possible, which requires to adopt standards and apply them in the type approval process.

Size of the problem

About 30% of all PTW collisions, which take place in Europe, happen at night. Thus, correct lighting is of high importance.

Scientific Background

2BESAFE's WP5.2 has successfully carried out tests on different front light configurations and identifies best solutions. WP5.3 has developed recommendations accordingly.

Expected impact

Other road users failing to perceive PTW is still a mayor reason for PTW crashes. To which extent this problem can be eliminated by improving front light configuration is still unknown. According to WP5.2 and WO5.3 results, recognition of a particular front light design by other road users is about 25% faster. Detection rates are significantly higher than for standard light configurations.

Implementation

Implementing standards on PTW front light configuration is, within the European Union, a task of the European Commission. After implementation of a draft regulation on type approval of two- and three-wheeled vehicles, this responsibility will move to the UN ECE-Committee. Elsewhere, respective legal and standardization bodies would have to act.

Acceptance

New standards require additional efforts in terms of manufacturing which might slightly increase purchase costs. Nevertheless, positive effects might be clearly understandable for PTW users and purchasers. In addition, a unique light layout might be well excepted by the motorcycle community giving them a sort of privilege.

Sustainability

It is unlikely that effects would fade. However, it is to a certain extent unknown, what will be the influence as soon as all PTW are equipped as proposed and what impact will be on the PTW, which are not yet equipped according to a new standard.

[45] Source: http://www.twenga.de 31 Jul. 2009

Transferability

New standards can be applied anywhere, however, it is know that many countries in the world do not have a comprehensive type approval process.

Costs and benefits

Neither the costs nor the benefit can clearly be quantified for the time being. There are some indications: Daytime running lights on cars, according to a study issued by the European Commission, pay back 1,50 to 2 Euros per Euro invested in terms of a reduction of crash costs. After-market daytime running lights for cars using LED technology are currently available at a cost fo 30 to 50 Euros.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

A comprehensive type approval process on lights may be considered a priority wherever such a process is not applied. Regular updating these standards to state-of-the-art is important. Research carried out within 2BESAFE's work package 5 clearly indicated that there is room for improvement in terms of conspicuity and recognisability of PTW.

Automatic Headlamps On (AHO)

Expert Assessment			
Overall		★★★★★	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★★★☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★☆☆

This measure is aimed at making the PTW rider more visible to other traffic, and to help reduce "looked but failed to see" collisions in which another vehicle failed to perceive the presence of a PTW in the roadway. These measures would increase the conspicuity of the PTW by automatically running the PTW's engine with headlights on at all times.

Example:

In 2001 the European Motorcycle Manufacturers Association (ACEM) adopted the practice of Automatic Headlamps On (AHO) for all motorcycles, scooters and mopeds. AHO means that the headlight is illuminated automatically whenever the ignition is switched on and, therefore, the normal on-off headlight switch is not even fitted.

http://www.acem.eu/cms/aho.php

The installation of daylight running lights is regulated in the transnational proposal for Supplement 10 to the 01 series of amendments to Regulation No. 53 (Installation of lighting and light-signaling devices on L3 vehicles) - ECE/TRANS/WP.29/2009/23 and was implemented in 2009. The process of implementation consisted of publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. Now it is law of the member states of the European Union. The amendment to regulation No. 53 makes it possible (optional) to install one or two Daytime Running Lamps (Regulation No. 87) on motorcycles. This shall lead to a better conspicuity of the motorcycle during daytime.

UNECE (2008). Installation of lighting and light-signaling devices on category L3 vehicles, p.15

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider. It addresses the vehicle categories motorcycle and moped. Besides, it addresses rider forgetfulness in the other countries where “headlights on” laws are enforced.

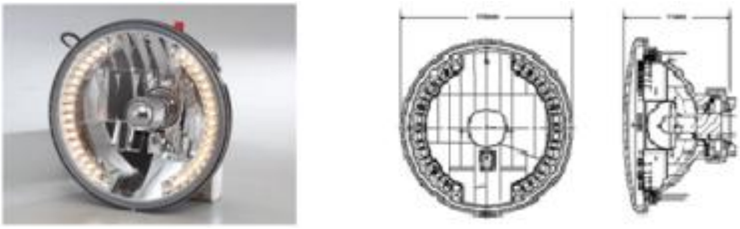

Figure 53: Daytime running lights[46]

Clear definition of the problem

PTWs are smaller and less prevalent than many other vehicles, and are often difficult to detect.

Size of the problem

In a 2-BE-SAFE laboratory experiment we found that car drivers are 10% less likely to enter junction when a conspicuous PTWV is present, relative to an inconspicuous PTW.

Scientific Background

According to Underwood et al. (2011), car drivers are less likely to enter a junction if there is a conspicuous PTW (headlights on, high-visibility clothing) present, in comparison with equivalent situations in which an inconspicuous PTW (no headlights, dark clothing).

Expected impact

By increasing the PTW's visibility it is less likely that they will be involved in a collision. Drivers will be more cautious about entering the roadway occupied by the PTW. However, as other road vehicles increasingly use running lights during daytime driving, there will be a reduced impact of PTWs using lights to make themselves conspicuous.

Implementation

PTW riders are particularly resistant to being given instructions about how they should ride. When we described the results of the 2-Be-Safe experiment to a UK weekly newspaper (MotorCycle News - MCN) their response was that collisions at junctions would be avoided if drivers were more careful. See MotorCycle News, 19 October 2011, page 11. The headline is "High-viz DOES improve safety". As another example of user resistance, see also page 7 of that issue of MCN in which a protest against prospective EU legislation preventing powertrain modifications, mandatory ABS, etc. The headline is "Join MCN protest: Help save biking from stifling EU measures". The protest took the form of a mass ride around Brussels, with banners, placards etc. Newspapers articles such as these raise awareness of safety measures, but they also indicate the resistance that will need to be faced.

Acceptance

See comments on "Implementation", above. Riders are resistant to legislation and argue that it is drivers who must change their own behaviour. They understand that high visibility works, but they feel that it is car drivers who should be educated. Mandatory implementation of AHO at European level is foreseen within the current draft for new European Regulation on type approval, it is supported by ACEM and other relevant organisation like ETSC (European Traffic Safety Council).

[46] Source: http://www.cens.com, 31 Jul. 2009

Sustainability

Since AHO device delivers riders from a useful task, this may in principle be considered highly sustainable. Use of headlights is commonly considered useful by riders. Additional risk taking or other compensatory behaviour by riders cannot be expected.

Transferability

Visibility depends upon ambient lighting, and so it is more important to increase visibility when riding when the light is poor, at dawn and at dusk. When riding in good daylight other measures need to be taken to increase driver awareness of PTWs.

Costs and benefits

The costs are minimal - the additional power required to ride with headlights is negligible. The benefits will range from zero to maximum, depending on whether failure to become visible results in a fatal accident.

Riders' perspective

☆☆☆☆☆

The riders' associations object to this measure because it infringes on the freedom of road users. Safety-conscious riders already rely on their judgment to decide when their comfort and safety requires turning their headlights on.

Priorities

AHO is proposed by the European commission within the draft Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles (COM(2010) 542 final). Comments and expert ratings fully support this measure.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010PC0542:en:NOT

Guidelines for Improvement of Rider Conspicuity during Daylight Riding

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★☆☆☆
Efficiency	★★★★★	Sustainability	★☆☆☆☆

This measure is aimed at making the PTW rider more visible to other traffic, and to help reduce "looked but failed to see" collisions in which another vehicle failed to perceive the presence of a PTW in the roadway. The measure would increase the conspicuity of the PTW by requiring/advising the use of high visibility clothing/helmet that uses reflective materials.

This measure contains recommendations for daylight riding. The main recommendation aims to make oneself as visible as possible from all sides. Therefore, it is suggested to wear light or brightly colored helmets and fluorescent clothing or strips. The use of dipped headlights is also recommended.

Example:

The UK Highway Code contains a guideline on daylight riding (Guideline reference number 86). The guideline was implemented by the Department for Transport in 2009.

Department for Transport (2007). The Official Highway Code, p.25

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider.

Clear definition of the problem

PTWs are smaller and less prevalent than many other vehicles, and are often difficult to detect.

Size of the problem

In a 2-BE-SAFE laboratory experiment we found that car drivers are 10% less likely to enter junction when a conspicuous PTWV is present, relative to an inconspicuous PTW.

Scientific Background

According to Underwood et al. (2011), car drivers are less likely to enter a junction if there is a conspicuous PTW (headlights on, high-visibility clothing) present, in comparison with equivalent situations in which an inconspicuous PTW (no headlights, dark clothing).

Expected impact

By increasing the PTW's visibility it is less likely that they will be involved in a collision. Drivers will be more cautious about entering the roadway occupied by the PTW.

Implementation

PTW riders are particularly resistant to being given instructions about how they should ride. When we described the results of the 2-Be-Safe experiment to a UK weekly newspaper (MotorCycle News - MCN) their response was that collisions at junctions would be avoided if drivers were more careful. See MotorCycle News, 19 October 2011, page 11. The headline is "High-viz DOES improve safety". As another example of user resistance, see also page 7 of that issue of MCN in which a protest against prospective EU legislation preventing powertrain modifications, mandatory ABS, etc. The headline is "Join MCN protest: Help save biking from stifling EU measures". The protest took the form of a mass ride around Brussels, with banners, placards etc. Newspapers articles such as these raise awareness of safety measures, but they also indicate the resistance that will need to be faced.

Acceptance

See comments on "Implementation", above. Riders are resistant to legislation and argue that it is drivers who must change their own behaviour. They understand that high visibility works, but they feel that it is car drivers who should be educated.

Sustainability

Unknown. Research is required to answer these questions. We do know that risk compensation is a possibility - riders may take more risks if they believe themselves to be safer.

Transferability

Visibility depends upon ambient lighting, and so it is more important to increase visibility when riding when the light is poor, at dawn and at dusk. When riding in good daylight other measures need to be taken to increase driver awareness of PTWs.

Costs and benefits

If riders are to wear high visibility clothing there will be financial costs involved. The benefits will range from zero to maximum, depending on whether failure to become visible results in a fatal accident.

Riders' perspective

★☆☆☆☆

The riders' associations support measures aimed at educating road users, and especially riders, about risks and good practices. However, wearing fluorescent clothing does not increase conspicuity in good lighting conditions, and its benefits should therefore not be exaggerated.

Priorities

We know that increased visibility reduces the likelihood that a car driver will enter a junction occupied by a PTW. However, this is a result obtained in a laboratory, and before recommending any changes to legislation a field trial is necessary to establish that the decision-making of car drivers can be made more cautious on actual roads, when a high visibility PTW is present.

Guidelines for Improvement of Rider Conspicuity during Night-time Riding

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★☆☆
Efficiency	★★★★★	Sustainability	★★★☆☆

The measure gives recommendation for riding a PTW in the dark. The main recommendations concern wearing reflective clothing or strips to improve visibility in the dark as these devices reflect light from the headlamps of other vehicles, making a PTW rider visible from a longer distance.

Example:

In the UK, behavioural recommendations for riding in the dark are in the UK Highway Code (Guideline reference number 87). It was implemented in 2009 by the Department for Transport.

Department for Transport (2007). The Official Highway Code, p.25

Beneficiaries:

The guideline addresses motorcycles and mopeds and aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider.

Figure 54: Reflective brace[47]

Clear definition of the problem

Rider conspicuity plays a role in the ability of other road users to properly identify PTWs, and correctly assess their position, speed, trajectory and behaviour.

Size of the problem

According to the results of MAIDS (2009), car drivers are the primary causation factor in over 50% of motorcycle accidents, and human error is the primary contributing factor in 87.5% of motorcycle accidents.

The same study points out that 81,2% of motorcycle accidents occurred during the day, with 15,1% of accidents occurring at night with street lighting, and only 3,7% at night without street lighting.

Scientific Background

Within the course of 2BESAFE, a serious of experiments have been carried out in order to determine the importance of rider conspicuity, alternative lighting patterns and other measure improving conspicuity. They all support a need for measures to improve consicuity.

[47] Source: http://highriders.co.uk/Motorcycle-Reflective-Brace-pr-1088.html, 06. Sep. 2010

Expected impact

Improving motorcyclist and motorcycle conspicuity with high-visibility equipment and active/reflective lighting is mostly beneficial in conditions of low background lighting, especially at night.

Considering that only a small minority of accidents occur at night, with an even smaller number at night without street lighting, the benefits of such a measure should not be overestimated.

It is essential to remember that conspicuity is not a matter of lighting where increased brightness results in increased conspicuity, but a matter of contrast. High contrast results in a motorcyclist-motorcycle combination being more easily and more quickly identified by other road users. In circumstances where there is ample background light, sunshine, or a bright environment (such as white-painted buildings in a city), high-visibility equipment with a strong yellow color and white reflective stripes can reduce the wearer's conspicuity, therefore increasing the risk of accident.

Measurement of the efficiency of conspicuity-based measures is extremely difficult. In the case of dedicated run-time-lights and daytime running lights for cars, in spite of more than fifty studies conducted over a period of thirty years, the effects of daytime lights have never been reliably measured, and there is no consensus over whether the measure is beneficial or not.

Implementation

Awareness campaigns can help increase the use of high-visibility equipment where needed among users. Awareness and education is important in educating users in the options available, and the circumstances in which the equipment should be used.

Making the use of high-visibility equipment compulsory is not recommended, due to adverse effects as listed above (low contrast in bright environments), as too little is known about its potential benefits on road safety, and other options exist.

Acceptance

It may be assumed that riders widely understand and accept that improvements of conspicuity provide improved safety to riders. Reality shows that willingness to use reflective material or other means to improve conspicuity is rather low, but increasing.

Sustainability

The measure is sustainable, as the increasing rate of use among European motorcyclists attests.

Transferability

The measure is transferable in other countries, but attention should be paid to local circumstances (weather, repartition of accidents between day and night) through research on accident causation factors.

Costs and benefits

Elvik and Vaa (2004) summarise a couple of studies on measures of improvement for pedestrians, bicycle riders and protective clothing for PTW riders, which are all highly cost-effective. Unfortunately, the issue of use of reflective material by PTW riders is not addressed.

Riders' perspective

★☆☆☆☆

The riders' associations support measures aimed at educating road users, and especially riders, about risks and good practices. However, wearing fluorescent clothing does not increase conspicuity in all cases, and its benefits should therefore not be exaggerated.

Priorities

According to expert statements and scientific evidence, improvement of night-time conspicuity of PTW riders should receive highest priority.

Xenon Headlamps

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★★★

Xenon headlamps provide an enlarged illuminated area, a higher light yield as well as a contrast-enhancing effect under dry weather conditions compared to Halogen headlamps.

The amendment to Regulation No. 53 (Installation of lighting and light-signaling devices on L3 vehicles) makes it possible to install XENON-headlamps (Class B, C, D or E of Regulation No. 113; Regulation No. 112; Regulation No. 1; Regulation No. 8; Regulation No. 20; Regulation No. 57; Regulation No. 72; Regulation No. 98) and/or an AFS-system on motorcycles.

Examples:

The use of Xenon headlamps is regulated in the transnational proposal for Supplement 10 to the 01 series of amendments to Regulation No. 53 (Installation of lighting and light-signaling devices on L3 vehicles) - ECE/TRANS/WP.29/2009/23 and was implemented in 2009. The process of implementation consisted of publication of scientific evidence, results of a technical working group plus lobbying and/or campaigning. Now it is law of the member states of the European Union.

UNECE (2008). Installation of lighting and light-signaling devices on category L3 vehicles, p.13

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider. It addresses the vehicle categories motorcycle and moped

Figure 55: Xenon headlamps[48]

Clear definition of the problem

Vehicle front lights are a necessary condition for nighttime riding to provide about road alignment, road characteristics and obstacles on the road. It may be assumed that improved front lights also improve information to the driver about these issues.

Size of the problem

About 30% of all PTW collisions, which take place in Europe, happen at night.

Scientific Background

There are numerous studies that deal with Xenon headlamps, e.g. “Influence of headlamps for accident avoidance, comparing Halogen to Xenon” published by Medical University Hannover or “Xenon performance” published by TÜV Rheinland. They all come to the conclusion that Xenon

[48] Source: http://www.ap-magazine.com, 31 Jul. 2009

headlamps enhance traffic safety. But in this context, it has to be mentioned that these studies do not directly target PTW riders, but all motorized road users.

One critical issue is given by the typical PTW driving dynamics. Whereas the headlamps of cars are nearly constant at the same height even while accelerating, the height of PTW headlamps varies. Thus, Xenon systems have to react according to the vertical movements evoked from the driving dynamics.

Expected impact

- This measure will have an impact on safety and environment.
- Compared to Halogen headlamps, Xenon headlamps reach a significantly higher light intensity as well as a higher light density. Thus, the PTW riders' field of view is enlarged due to this headlamp. It is supposed that the number of severe nighttime collisions could be reduced by 50% on rural roads and by 30% on highways. But due to the presence of adequate road lighting, there is no safety impact expected in urban areas. These figures are based on all collisions and do not directly refer to PTW collisions.
- Besides, Xenon headlamps have an impact on environment as they produce less CO2 emission (1,3g/km less compared to Halogen bulbs) and less waste (resulting from a longer bulb lifetime).
- The success could be measured by using the ratio of nighttime-to-daytime accidents. This ratio should decrease the more vehicles are equipped with Xenon headlamps.
- The risk of dazzling effects is very likely: On the one hand, a rain-wet surface reflects Xenon light more than the light of Halogen lamps, which means that the driver coming in the opposite direction is more dazzled by Xenon headlamps than by Halogen headlamps. On the other hand, it is quite likely that dazzling effects are produced by PTW driving dynamics: Although an automatic headlamp beam height control is required for Xenon lighting devices, this control has no influence on a faulty basic setting of the headlamps. Thus, especially during the acceleration process as well as on hilltops or under different loading conditions, the light spectrum might not be concentrated on the surface but a little bit higher resulting in dazzling effects for the driver coming in the opposite direction.

Implementation

The main barrier concerning the implementation of this measure are the technical requirements: just like cars, PTWs have to be equipped with an automatic front light inclination control, with a headlamp wash system and with a system that guarantees that the dipped beam is turned on even when the high beam is in use.

Implementation can be either done on a mandatory basis, as supplementary equipment by the manufacturer or as after-market product

Acceptance

Xenon lamps are significantly more expensive than conventional head lights. Mandatory implementation might, hence, be objected by the riders and the industry.

Sustainability

Improved visual conditions might seduce riders to drive faster, which could eliminate the safety effect.

Transferability

Xenon headlight could be sold where conditions for type-approving them are given.

Costs and benefits

No studies have been found dealing with the costs and benefits of this measure with respect to PTW riders. But according to a study, which just involves passenger cars, the benefit-cost ratio is 3.5 in EU 27.

Riders' perspective

★★★★★

(no comment)

Priorities

Expert rate this measure rather low. Clear evidence about the safety impact for passenger cars might not appear to the same extent for motorcycles. Considerable costs have to be considered as well as the fact that night time riding is not a key problem.

Automatic Dipped Beam Inclination

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	★★★★★
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	★★★☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★★★★

To ensure that the conspicuity of PTW riders is not adversely affected by the load of the vehicle, measures have to be defined that allow the measurement of the variation of dipped beam inclination as a function of load.

Example:

In Germany, the variation of dipped beam inclination is regulated in the ISO 9987: Motorcycles; measurement of variation of dipped beam inclination as a function of load. The guideline was implemented in 2002.

Beneficiaries:

The measure aims at reducing the number of PTW accidents caused by a lack of conspicuity of the PTW rider.

Clear definition of the problem

Normally, headlights are fixed on a PTW, which means that the range of headlights varies with the load of the vehicle. Two problems occur, if the headlight is not adjusted manually according to the loading conditions: PTWs may bedazzle oncoming and other road users and the road is not enlighten appropriately when riding during darkness.

Size of the problem

According to collision numbers it may be estimated that about 10% of PTW trips are undertaken carrying pillion passengers. According to MAIDS data, 4 of motorcycle accidents occur on dark roads, 8% during dusk or dawn and 15% on road with road lighting. It is unknown, which share of these collisions and collisions concerning other road users could be prevented by automatically adjusted headlights.

Scientific Background

Headlight design significantly influences perception of PTW. However, no study could be found which evaluates the possible impact of automatic headlight adjustment. The measure solves the technical problem according to the quality of the device used.

Expected impact

Collision counts may be expected to decline in particular during darkness. PTW purchase cost will increase slightly.

Implementation

The measure would have to be implemented in Europe either by legislation of changing the respective ECE standards.

Acceptance

There is no experience with acceptance of this measure. Manufacturers will have to be consulted concerning technical feasibility. Riders might be concerned about additional cost.

Sustainability

It is unlikely that any fading of effects will take place.

Transferability

There are no barriers except those mentioned under "acceptance".

Costs and benefits

No data available.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

Experts rate this measure rather low. The results of 2BESAFE's WP5 propose that dipped beam is not the optimum in terms of enhancing conspicuity, alternative lighting patterns are concluded to be more effective. Hence, there is no sound basis for the arguments supporting the implementation of automatic dipped beam inclination, where night time riding is not a major problem of PTW safety as well.

Adaptive Front Lighting

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★★★★
Total impact	★★★★☆	Implementation	★★★☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★★

Adaptive headlights improve the illumination of the motorcycles path on curves. They ensure that the illumination from the headlight is projected on the intended path of the motorcycle when cornering by adjusting it in accordance with the speed and position of the bike.

Example:

Monash University's Report on ITS and Motorcycle Safety mentions the Yamaha ASV-2 Model 1, which has been equipped with adaptive headlights.

Bayly M. et al (2006). Intelligent Transport Systems and motorcycle, pp.22-23

Beneficiaries:

Improving the illumination of the path of motorcycles improves the sight of motorcyclists and can therefore lead to a reduction of the number of PTW accidents. Monash University's Report on ITS and Motorcycle Safety say that adaptive headlights may also serve to increases the conspicuity of the motorcycle to other vehicles on corners.

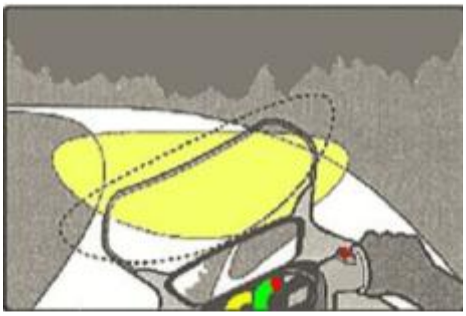

Figure 56: Adaptive front-lighting system compared with traditional headlights[49]

Clear definition of the problem

- Bad illumination of the road in curves can be considered as a severe problem for PTW riders.
- When cornering the change in the optical axis of the headlight reduces visibility of the road as the beam illuminates rather the shoulder than the road. Therefore minimizing the horizontal inclination of the headlamp can improve the visibility.
- When a motorcycle inclines on a curved road the headlamp of a conventional motorcycle inclines horizontally with the vehicle body. The illuminated area in front of the motorcycle rider (the range of road illuminated) becomes limited (cf. Motoki et al., 2009).

Scientific Background

A simulation survey and an actual driving survey to test the visibility of motorcycles of the Japanese Automobile Research Institute demonstrated that a motorcycle Adaptive Front Lighting System enhances visibility for the rider while the motorcycle is being driven on curved road. Similar tests of the Institute on the discomfort glare showed that a critical issue to be considered is the adjustment amount of horizontal inclination: "A horizontal inclination adjustment system (HIAS) may be installed. However, the adjustment amount of horizontal inclination shall not exceed the vehicle's bank angle."(Motoki et al., 2009)

In recent rears four-wheeled vehicles have increasingly been equipped with Adaptive Front Lighting Systems. For motorcycles so far little research has been done on the effects of Adaptive Front Lighting Systems. The Yamaha ASV-2 Model 1 has been equipped with Adaptive Front Lighting System but at this stage it is still an emerging active ITS in motorcycles (cf. Bayly et al., 2006).

Implementation

- critical issues: Discomfort glare for oncoming drivers
- things to avoid: the adjustment amount of horizontal inclination should not exceed the vehicle’s bank angle in order to avoid discomfort glare.
- Enforce scientific research of value, safety benefit and critical issues (e.g. discomfort glare) of Adaptive Front Lighting systems.
- Conduct information campaigns on the benefits of Adaptive Front Lighting Systems in order to increase the demand for riders who are buying a new motorcycle.

Expected Impact(s)

- This measure will enhance the visibility for riders while the motorcycle is being driven on curved roads.
- This measure will contribute to reducing accidents during night time and in poor visibility conditions.
- Side effects that might occur: discomfort glare for oncoming drivers

[49] Source: http://www.yamaha-motor.co.jp/global/news/2000/11/15/asv2-02.html, 19 Oct. 2009

Acceptance

The general acceptance as well as the acceptance of motorcycle riders themeselves will be very high. Concerns might be raised by other road users (due to the risk of discomfort glare for oncoming drivers).

Sustainability

No risk of fading effects and only low influence on riding behaviour is to be expected. Speed driven in curves might increase due to an enhanced visibility of the path of the motorcycle rider. The measure is highly transferable in all European countries.

Transferability

Adaptive Front Lighting Systems should be implemented on an EU-Level.

Costs and benefits

Cost-benefit figures cannot be provided. However, costs for Adaptive Front Lighting Systems as additional equipment on motorcycles are relatively affordable (e.g. an additional safety package for BMW K1600 that includes Adaptive Front Lighting costs about 995 € in Austria).

Riders' perspective

★★★★☆

The riders' associations support the development of safety technologies that answer the needs of riders, including investigation into more effective lighting.

Priority

Great priority must be given on the development of Adaptive Front Lighting Systems and on the introduction of AFS as standard equipment on motorcycles on EU-level.

Alternative Front Light Patterns

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★★☆☆
Total impact	★★★★☆	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★☆☆☆
Efficiency	★★★★☆	Sustainability	★★★★☆

Alternative Front light pattern aim for providing PTWS a unique visual signature (signal pattern) which, which clearly differentiates them from cars and facilitates their perception by the other road users. Such visual configurations as distinctive features can be e.g. implemented by varying the colour of the headlights (e.g. yellow) or by dedicated positioning and lay-out of PTWs' frontal headlights (e.g. T-light configuration, LONG-Light-system by Honda, triangular configuration).

Example:

The T configuration uses vertical linear lights at the fork and horizontal ones in the rear mirrors. The headlight is positioned at the intersection of the two. For this particular arrangement three design aspects were incorporated: a.) the real size of the motorcycle front is very well indicated through the position of lights at the geometrical endpoints of handlebar and fork, b.) the use of a maximum horizontal and vertical distance between two light sources leads to a separate detection of lights even at long distances, b.) this specific signal pattern is very similar to an abstract picture of a motorcycle front as T shaped.

Figure 57: Alternative Front Light Patterns; T-light configuration

Beneficiaries:

Alternative light pattern aimed for a faster recognition and identification of PTWs by other road users through to a unique visual signature. Moreover, the perception of PTW's speed and distances by other road users, e.g. for oncoming motorcycles at intersection, shall be facilitated, which is sub-optimal for PTWs with a single headlight.

Clear definition of the problem

Perception and recognition failures contribute to the risk of encounters between PTW riders and other vehicle drivers. The MAIDS (ACEM, 2004) study indicated that a significant percentage (36.6%) of all PTW accidents arose from the inability of the other vehicle driver to adequately see the PTW rider. According to analyses in the UK (McCarthy et al., 2007), traffic scan errors by the other-vehicle drivers were accountable for causation in 67% of the investigated multi- party accidents. Such accidents typically occur at crossroads, T-junctions and involve right-of-way violations by the other vehicle driver or situations in which vehicle drivers perform a U-turn despite an approaching PTW (e.g. Kramlich, 2002). As the primary reason for the fact that PTWs run a greater risk of being seen too late or not at all, many authors (e.g. Williams and Hoffmann,1979; Rumar, 2003) stressed their poor conspicuity resulting from their small frontal surface. Difficulties in estimating the speed of PTWs and difficulties in identification due to the non-distinctive fronts of several PTW categories were noted as further reasons.

Scientific background

Hole and Tyrrell (1995) showed that a distinctive feature (provided by frontal lights) will be associated with the presence of a motorcycle, and in consequence, will be used by other road users as cue to shortening recognition processes and decisions about whether a motorcycle is present or not. The authors concluded that driver develop a 'perceptual set' for detecting motorcycles. Further results from Rößger et al. (2012) indicated that the inclusion of a 'T' light configuration on a standard motorcycle led to improved conspicuity compared with a standard headlight.

Tsutsumi & Maruyama (2008) could demonstrate that specific frontal light arrangements highlighting the size of PTWs enabled a better perception of PTWs distance, speed and of its time to arrival by drivers. Similar results are recently reported by Gould et al. (2011).

Implementation

For implementation of alternative front light pattern the legal situation concerning the installation of "dedicated daytime running lights" on motorcycles in Europe as to taken into consideration. The introduction of certain light arrangements would require changes to various specifications and regulations.

A further aspect that has to be considered is the acceptance of PTW riders when it comes to new lighting design solutions (e.g. T-Design). Within the project, especially riders with older bikes and old-timers expressed their reservation towards this measure. Results from focus groups interviews were that initially rather negative attitudes towards new lighting solutions diminished in the course of the interview process. That highlights the need to involve the rider community into the process of development and implementation.

Moreover, potential glare effects on other road users have to take into account. Additional light source with highly emitting white LED-daytime-running lamps which tend to cause glare are likely to negatively affect other road users' acceptance towards this measure and might also foil intended safety benefits

In this context, potential interference with the perception of other light source information (e.g. such as the turn indicator) has to be consider for implementation. Results from the project emphasise adaptive configurations which dimes the light intensity when turn indicator is in use. Results from focus group interviews with PTW riders suggest that the development of self-adaptable (to weather conditions, light conditions) systems is seen as a valuable solution.

Promotion of serial- productions of big manufacturers and prioritizing serial-products instead of re-fitting solutions could facilitate the implementation of this measure.

Expected Impact(s)

Results from studies (see above) indicate that the measure impacts other road users' perception of PTWs in terms of a faster recognition and a better perception of PTWs' speed, distance and time to arrival. Hence, that would imply that the measure positively affect the interaction between PTWs and other road users at intersections and T-junctions and will lead to a reduction of right-of-way violation which are caused by late detection of PTW and/or by wrong estimations of PTWs speed.

Acceptance

Experts judgements on the expected acceptance by riders towards revealed that the acceptance measure is considerably high, corresponding with a rating 9 on a rating scale from 0 (low acceptance) to 10 (high acceptance). Experts also judged that the measure rather will receive approval by the industry (8), by educational bodies (8), by infrastructure providers (8) and by legislative bodies (8) rather. Expected acceptance by other road user (6) was lower rated by the experts.

Studies investigating riders' acceptance towards conspicuity treatments indicated higher acceptance rates for alternative front light configuration compared to dynamic helmet lights and warning vests. Focussing on the underpinning determinants, the perceived effectiveness with respect to conspicuity was equally high between all three treatments (Krautscheid et al., Del. 19, WP 5.3). The clearest differences between the treatments were observed for impact on self-image and perceived impact on riding pleasure. For both scales, a T light configuration elicited the highest ratings, followed by the dynamic helmet lights. The acceptability towards conspicuity aids is essentially correlated with riders' perception about the treatments' impact on his image as a rider. Riders apparently disapprove conspicuity aids when they feel that the treatment is not in line with their self-image or with the bike itself despite the fact that they perceive that the treatment would enhance their conspicuity, and thus, their safety.

One striking finding of focus group interviews (Krautscheid et al., Del. 19, WP 5.3) with riders was that initially rather negative attitudes towards new lighting solutions and conspicuity enhancing measures diminished in the course of the interview process. That hints to the importance of communication and educational processes with respect to the development of acceptance.

Sustainability

This measure is believed to be sustainable because of the underlying basic principles, e.g. enhancing object / background contrast, quick recognition of objects based on well-learned cues, perceived time to arrival based on changes in retinal information). However, the sustainability is clearly depending also from other factors, e.g. if the alternative light front pattern is not a distinctive feature beacuase it is used also for other vehicles it is not effective anymore as a specific cue for detection. Moreover, relatively little is known about risk compensation mechanism in association with conspicuity treatments.

Transferability

The transferability across EU countries might provide a challenge in terms of legal and acceptance issues, it should be however feasible in the long run. A further aspect of transferability concerns the application (transferability) to (across) several motorcycle categories (sport bikes, old timer etc.), further research in motorcycle design as well as in acceptance of riders is needed to focus on that aspect of transferability.

Costs and benefits

No dedicated cost-benefits analyses related to that measure are available.

Riders' perspective

★★★★★

The riders' associations support the development of safety technologies that answer the needs of riders, including investigation into more effective lighting.

Priorities

As most studies focussing on the impact of alternative front light patterns were conducted in laboratory or as static perception tests, further confirmation of the effectiveness by using complementary methods (e.g. naturalistic studies) is needed before recommending any changes to legislation.

9. Environmental Issues

Requirements concerning Air Pollution

Expert Assessment			
Overall		★★☆☆☆	
Size	☆☆☆☆☆	Transferability	★★★★★
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★★☆

Air pollution can have negative effects on human beings. Therefore, people must be protected against gaseous pollutants (carbon monoxide, hydrocarbons, and nitrogen oxides) and visible air pollution to avoid serious diseases. Uniform limit values and common methods for testing them make it easier for manufacturers to abide the rules.

Example:

In 1997, the European Commission adopted the Directive 97/24/EEC on certain components and characteristics of two- or three-wheeled motor vehicles. Chapter 5 is about measures to be taken against air pollution caused by two- or three- wheeled motorcycles and contains limit values for gaseous pollutants and visible air pollution as well as exact descriptions of the test conditions.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

To address the issue of air pollution, ACEM members have proposed, at the occasion of their 5th Annual Conference in Brussels on 1 December 2008, to set two new emissions reduction stages: Euro 3 and Euro 4 for mopeds and Euro 4 and Euro 5 for motorcycles. These new Euro standards are proposed to be introduced in the legislation for application in 2012-2013 and 2015-2016.

ACEM (2010). The Motorcycle Industry in Europe – ACEM Report, p.29

But as there is a lack of official data concerning CO_2 emissions, a unified test should be introduced. In this respect, instead of categorizing motorcycles by segment (i.e. touring, enduro, etc.) or by engine capacity banding, simple publication of the data in a unified way for all PTWs, as done for passenger cars, should be favored.

http://ec.europa.eu/enterprise/sectors/automotive/files/consultation/2_3_wheelers/acem_en.pdf

Beneficiaries:

As part of the approach to reduce CO_2 emissions caused by means of transport, it is necessary to draw up a regulation, which sets emission performance standards for new PTWs.

Clear definition of the problem

If conditions remain the same as they are today, the European Commission[50] estimates that mopeds will represent more than 35% of all hydrocarbon emissions from road traffic by 2020, and motorcycles over 20%. This discrepancy between vehicle types is due to the relatively late introduction of Euro emission regulations for two-wheelers.

Size of the problem, Scientific Background, Expected impact

The European Commission is proposing, in its draft regulation for the type-approval of two- and three-wheelers, the introduction of new emission limits for PTWs, emission measurement standards, and CO2 labeling of vehicles.

[50] http://ec.europa.eu/enterprise/sectors/automotive/files/com-2010-542_en.pdf

The new emissions limits, similar to those implemented for four-wheeled vehicles, will also include **durability requirements** for the declared environmental performance.

Gradual strengthening of emissions			
	Optional	Mandatory New bikes	Mandatory Existing models
Euro 3 (<50cc) Euro 4 (>50cc)	07/2013	2014	2015
Euro 4 (<50cc) Euro 5 (>50cc)	2015	2017	2018
Euro 5 (<50cc) Euro 6 (>50cc)	2018	2020	2021

In order to sanction the environmental performance laid out, it is proposed that a single revised version of the currently used World Motorcycle Test Cycle (WMTC) be introduced. Unlike tests cycles in use for other categories of vehicles, WMTC is expected to be more accurate and closer to real-life riding conditions. The test cycle, to be used to measure polluting emissions during the type-approval process and the life cycle of the vehicle, will be further defined in delegated acts.

For all powered two-wheelers, manufacturers will have to display for the customer the amount of CO2 liberated by the vehicle, in g/km. The display will be similar to the one currently used for personal cars.

These measures will be accompanied by durability requirements. Manufacturers will have to guarantee the continued compliance of the exhaust systems with the stated limits for the mileage described below for each category:

Durability requirements	Euro 3 mileage	Euro 4 mileage	Euro 5 mileage
Mopeds	10,000 km	11,000 km	12,000 km
Bikes and tricycles Max speed <130km/h	18,000 km	20,000 km	30,000 km
Bikes and tricycles Max speed >130km/h	30,000 km	35,000 km	50,000 km

Implementation

Implementation of exhaust gas regulation normally is an issue of legislation.

Acceptance

The commitment of the industry has to be recognised.

Sustainability

The measures are regulatory and are therefore considered to be highly sustainable. The introduction of the latest stages, Euro 6 for motorcycles and Euro 5 for mopeds, will be subjected to an impact assessment of the measures previously introduced.

Transferability

Transferability is high toward countries using European type-approval. In other countries, the lessons learned in the assessment of the introduction of the gradual strengthening of emissions limits and durability requirements can guide policy in that field.

Costs and benefits

The costs for the user have been estimated by ACEM[51], the motorcycle industry in Europe, to range from 180 to 240€ on a new vehicle, depending on the type of vehicle (including catalytic converter and control of evaporative emissions), which represents a price increase of up to 12%. The impact will be highest on low engine size classes (<125cm3) which represent 80% of sales in Europe.

Riders' perspective

★★★☆☆

The riders' associations support measures aimed at increasing the efficiency and environmental performance of PTWs. However, requirements concerning air pollution are a public health and environment issue, and not a road safety issue.

Priorities

Greening mobility is one of most important challenges of this century.

Requirements concerning the Permissible Sound Level

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	★★★★☆
Total impact	★☆☆☆☆	Implementation	★★☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★★☆

The sense of hearing must be protected from permanent or short but loud noise exposure. But not only hearing impairments are put down to noise exposure, also cardiovascular diseases and stress can be caused by it. Therefore, limit values for two- or three-wheeled motor vehicles were set to protect motorcyclists and other people.

Example:

In 1997, the European Commission adopted the Directive 97/24/EC on certain components and characteristics of two- or three-wheeled motor vehicles. Chapter 9 is about the sound level of two- or three- wheeled motorcycles and contains limit values for the different vehicle categories and exact descriptions of the test conditions.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

Beneficiaries:

In order to protect abutting owners as well as other road users from noise pollution, it is necessary to keep the sound level of PTWs to a minimum. This way, especially the external costs of traffic – in particular the medical costs – can be reduced.

Clear definition of the problem

The primary problem involved in this measure is related to both maximum noise levels emitted by PTWs and from illegal exhaustion systems. Although, this practice has diminished throughout the years, there are still riders that customize their PTWs resulting in increased noise production.

51 http://circa.europa.eu/Public/irc/enterprise/automotive/library?l=/mcwg_motorcycle/meeting_june_2009/price_impactspdf/_EN_1.0_&a=d

Size of the problem

Although, PTWs are much less frequent in traffic, especially in northern countries, they emit 6dB higher level than cars. Therefore, they may not exceed the mean noise level during a busy day in an urban road but they do definitely exceed the maximum. The latter in combination with illegal alterations to PTWs creates a realistic both environmental and safety issue.

Scientific Background

There are no specific recommendations and specific limits in Europe. According to Vergote (2001) there is a variation in margins (4-6 dB) for PTWs to the limit value

Measuring methods are different across countries and the corresponding limits. For example, in Japan noise emission limits are 73 dB (Anon, 1999), which is no less than 4 dB lower than in Europe for motorcycles with engine capacities 125- 175 ml).

Implementation

Differences are found for other countries as well. The problem becomes more complicated when is taken into consideration also that PTWs may be designed in one country, assembled in another and sold in more than one or two of them. Therefore, the universality of the recommendations is questioned at first and at second does not depend solely on the PTW. Current issues that are important is to clarify noise levels for both the motorcycle and the countries to be used with taking into account how permissive or stringent the measures need to be.

Expected Impact(s)

The primary impact is environmental. Increased noise is harmful for the environment without any other –even by productive- benefit. Its impact is also important to road users' health and not only the riders'. It is difficult to estimate the size of impact but 5-10% decrease in noise levels would be desirable. A success for this measure would involve lower noise levels across different European countries. Probable future effects are that new PTW models would involve fewer emissions and therefore recommendations might be changed. Expected impact to Environment: 4.

Acceptance

Higher acceptance is expected by governmental and public bodies than riders themselves. Noise levels are high in urban roads and in southern countries (higher number of PTWs) and riders in these conditions are more into commuting rather than leisure. Therefore, the success for noise emissions for these conditions could be successful.

Sustainability

Sustainable could be attained if recommendations are accompanied by a strategy for their implementation. However, the deployment of new "environmentally friendly" PTWs could change both the status and the usability of such recommendations.

Transferability

Transferability entails collaboration of industry and public bodies in order to yield a basic recommendations list on European level based on the country specific existing recommendations (if any). Transferability on a larger scale involves harmonization of recommendation first and adjustment to environmental characteristics as a second step.

Costs and benefits

Costs due to new sound level requirements can be high, taking into account design modifications (e.g. exhaust system) and retain engine performance without drop in delivered power. However, benefits are high for the environment.

Riders' perspective

★★★★★

The riders' associations support realistic and acceptable sound level regulations. Consultations with stakeholders show that there is a wide consensus on the current level of sound emissions allowed by

European law (80db for motorcycles and 71db for mopeds, which represent the majority of urban PTW traffic) and that no further reduction is required.

Priorities

There is clear evidence that traffic noise is a major issue of public health. Efforts to reduce the overall nose emission by motorcycles should be flanked by enforcement measures preventing unnecessary tuning and tampering with negative impacts to nose emissions.

10. Protective Equipment

The basic principles of prevention in terms of workplace safety may be applied for PTW user safety as well:

- Avoid risks
- Evaluate unavoidable risks
- Combat the risk at source
- Adapt work according to principles of human abilities and behaviour
- Apply collective protective measures
- Apply individual protective measures

In other words, the transport system should first be adopted to also fit the needs of riders. Where this approach fails, the tools and machinery should be improved. If all other measures fail, personal protective equipment shall eliminate or reduce remaining risks.

Since it is quite unlikely that roads and vehicles will in short course provide a system perfectly safe for PTW users, there is an urgent need to exploit the potential of personal protective measures.

As a result of the traffic system failing to provide a perfectly safe riding environment, PTW riders are nowadays mainly considered to be vulnerable road users. This issue may be addressed by implementation of technical standards for protective equipment, campaigning to encourage use, obligations to use and enforcement of such obligations.

Standards for Motorcyclist Protective Clothing

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★★★☆
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★☆☆☆

Whatever riders wear, it has to fulfil two basic requirements: The clothes should protect from environmental conditions such as wind, water and cold, which is a safety issue as well, although it might mainly be considered an issue of comfort. They must also alleviate the effects of collisions. As matter of fact, clothes must not handicap the rider in handling the vehicle.

In terms of standardizing, there are two issues to consider: On the one hand, standards shall settle a harmonized understanding of how the term "protective" has to be read. In other words, safety shall not be compromised in competition on the market. On the other hand consumers need to be aware, which level of protection they can expect from a certain product. Hence, compliance to certain standards must be achieved either by legal obligations or by consumer testing. Whatever is applied, technical standards about how to test protective equipment have to be made available.

Examples:

Part 1 of the EN 13595 defines general requirements for jackets, trousers and one-piece or divided suits. In the second part the test method for determination of impact abrasion resistance is specified. Part 3 is about the test method for determination of burst strength and in the fourth part a test method for determination of impact cut resistance is described. This standard was implemented in 2002 in European Countries such as Switzerland and Germany.

http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_10883.html

In its road safety policy orientations up to 2020, the European Commission states that standards for personal protective equipment should further be developed and researched to reduce the consequences of accidents.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

By law, in Europe, motorcycle clothing can only be designated "protective" if it is capable of providing protection from injury. The Personal Protective Equipment Directive (PPE, 89/686/EEC) requires that any clothing or equipment sold or provided as a source of protection from injury must be categorized as protective (PPE) and comply with the relevant European Standard:

- Standard EN 1621-1 covers the effectiveness of mechanical impact protection. Hereby, the clothing has to include protection to this standard at key vulnerable locations of the garment.
- Standard EN 13595 covers the protective qualities of the garment, including construction techniques and potential to resist abrasion.
- Standard EN13594 covers gloves and EN 13634 covers footwear.

Protective equipment, which is produced according to European standards, will wear the CE logo and display several of the herein before mentioned European. Garments complying with these or similar standards will generally have the following features:

- A full lining with the lining not attached to the outer shell in zones 1 and 2 (see Figure 58).
- A double thickness outer shell material in high risk areas such as zones 1 and 2.
- Impact protection tested to EN 1621-1 in zone areas.
- Several rows of stitching in all structural seams with protected/covered rows. By covering some rows of stitches, they are protected from sunlight and general abrasion that can seriously weaken the seams prior to an accident.
- Adequate adjusters at the ankle and wrist cuffs to ensure that the garment remains in place during an accident.

http://www.bikesafe.co.uk/Bikesafe/ceclothing/CEprotective.html

According to the PROMISING project, it is desirable that some indication should be given to prospective purchasers of clothing that will indicate to what extent the clothing will achieve protection as follows:

- Prevention of most laceration and abrasion injuries that occur when a rider slides on the road surface after falling off.
- Prevention of contamination of open fractures by road dirt.
- Reduction in the severity of contusions and fractures, with the prevention of some fractures and joint damage.
- Reduction in the severity (or prevention) of muscle stripping and degloving injuries, particularly to the lower leg and hands.
- Prevention of accidents by maximizing the conspicuity of the rider. Prevention of accidents by maintaining the rider in good physiological and psychological condition by keeping the rider dry, warm, comfortable and alert.

Besides, the correct choice of protective clothing is also essential for improved safety as the clothing worn can both increase and reduce various problems relating to physiological stress (cold stress, wet stress, vibration and noise stress, postural stress, heat stress). This stress occurs when physiological work has to be done to counter the discomfort, when there is a homeostatic physiological response to the changes the physical factors have caused in the body or when a task is continued to the point when fatigue occurs. The discomfort caused by physiological stress is important because it can increase the likelihood that a rider might have an accident because it can lead to impaired sensation, to a reduction in the accuracy of the control of actions, to dulled responses and increased reaction times, to impaired motor responses as well as to increased fatigue.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, pp.170-174

Beneficiaries:

The various existing standards concerning protective clothing improve the riders' safety as in the case of an accident, the injury severity is reduced.

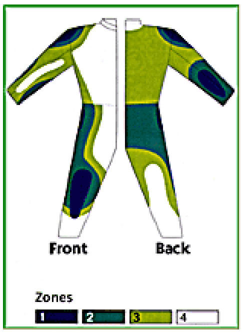

Figure 58: Zone guide for protective clothing[52]

Clear definition of the problem

Purchase of protective clothing is a task for the individual rider. It may be assumed that purchasers do not have the ability to check safety performance of protective equipment in a shop. Consumer testing by motorcycle journals and organisations for consumer protection may be supportive. However, there is an urgent need to define standards for protective equipment in order to ensure that a driver willing to invest in personal protective equipment to a reasonable extent gets what she/he is paying for.

Size of the problem

This measure targets the whole market for protective equipment for PTW riders. Almost every PTW accident can to a certain extent be influence by protective clothing.

Scientific Background

Several studies have been executed on the impact of protective clothing. See "costs and benefits" section.

Expected impact

See "costs and benefits" section.

Implementation

EN 13595 only covers suits, jackets and trousers for professional motorcycle riders. It has not been designed as a standard for all motorcycling equipment. As such, it does not cover gloves.

Many motorcyclists have long regarded jackets and trousers made from leather and denim as acceptable protection. In many cases, leather jackets have been proved to be more effective in protecting the motorcyclist than purpose-made equipment. Due to the variety of accessories available - for all sizes, styles, needs and price - most of these items would not undergo the lengthy and expensive standardization process.

Pushing for all products to comply with CEN standards on protective equipment would have the effect of banning from use the leather and denim equipment that riders have used and trusted for decades. This would result for lower protection for users.

Motorcyclists would see their choice of options in protective equipment reduced, and their freedom of choice as customers curtailed.

Currently, standards only exist for impact-absorbing equipment, not for garments, due to the reasons listed above. Nor CEN, nor the users or the European Commission see a need for standards for protective clothing.

As with all standardization processes, it is essential to avoid creating requirements that stand in the way of future developments, such as the use of new fibers, material or construction.

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[52] Source: http://www.bikesafe.co.uk/Bikesafe/ceclothing/CEprotective.html, 28 Jul.2010

Acceptance

Implementation of standards for protective equipment is an issue mainly addressing the industry. It may be assumed that riders will highly appreciate that (of they know), since it provides reasonable safety of investment.

Sustainability

Standards are a key issue in providing sustainable effects.

Transferability

Once they are developed, standards on protective clothing can be applied anywhere, for consumer testing or as a legal provision.

Costs and benefits

Elvik and Vaa (2004, pp 652 ff) have analysed a couple of studies on the impact of protective clothing. Respective injuries are expected to decline between 33% and 50% by use of protective equipment. The benefit-cost ratio was estimated to be 5.3, which makes protective equipment a highly efficient way of reducing number and severity of injuries. However, the article only addresses the use of protective equipment, but not the impact of having technical standards.

Riders' perspective

★☆☆☆☆

The riders' associations support standards for protective elements within items of clothing (e.g. knee or elbow pads, back protectors) because they ensure products offered for sale meet minimum requirements for quality and safety. However, further standards covering garments would be unnecessary and counter-productive as they would leave out the vast majority of common and reliable protective items such as leather jackets, for which testing would be too expensive for manufacturers to consider considering the large quantity of products offered on the market.

Priorities

The expert ratings for this measure are rather low, although standards on helmets and other protective equipment and the use or protective equipment are rated high. This might be due to the experts being in favour of using "what is available" and in a second step improve quality of products. Nevertheless, comprehensive technical standards are a necessary condition for mandatory use of any kind of protective equipment.

Standards for Motorcycle Helmets

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★★
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★★★☆☆	Acceptance	★★★☆☆
Efficiency	★★★★☆	Sustainability	★★★☆☆

The primary goal of a motorcycle helmet is motorcycle safety - to protect the rider's head during impact, thus preventing or reducing head injury or saving the rider's life. The standards for motorcycle helmets ensure that the helmets are able to protect the wearer in the case of a collision.

There are numerous standards for motorcycle helmets in the market. These safety standards are enforced by the respective governments to protect motorcycle riders. Motorcycle helmets sold in the market that have attained certain requirements are subjected to laboratory tests. The laboratory tests measure a helmet's ability to absorb impact. The effectiveness of the retention system that keeps the helmet on the head and accessories such as helmet visors are also tested.

Examples:

The US official law states that all motorcycle helmets sold in the U.S.A. must be DOT "certified". Helmets that do not meet the minimal DOT certification standards may not be sold as motorcycle helmets. Federal Motor Vehicle Safety Standard (FMVSS) provides the requirements for "DOT" certification of all helmets sold in the United States for use by motorcyclists.

Compared to the DOT standard, the Snell Memorial Foundation has developed stricter requirements and testing procedures for motorcycle helmets with racing activities in mind such as drag racing, motocross, karting. However, buying a helmet that has SNELL certification is completely voluntary. The SNELL standard does not replace the DOT standards. Many motorcycle riders in North America consider SNELL certification a better benefit when considering buying a helmet. This is because SNELL standards allow more gravitational forces to be transferred to a rider's head than the U.S. Department of Transportation (DOT) standard.

Economic Community of Europe (ECE) is actually the most commonly used motorcycle helmet safety standard internationally as the ECE 22.05 is required by over 50 countries worldwide. One of the advantages is the requirement for mandatory batch testing of helmets before they are released to the public. This means that the quality of the helmet in meeting the ECE 22.05 standard is assured by the compulsory sample testing of every production of helmets before they leave the factory.

In the United Kingdom, the Auto-Cycle Union (ACU) defines a stricter standard for racing than the legal minimum ECE 22.05 specification. Only helmets with an ACU Gold sticker are allowed to be worn in competitions or at track days. Many riders in the UK choose helmets with an ACU Gold sticker for their regular on-road use.

http://www.helmetboys.com/pages/World-Motorcycle-Helmet-Safety-Standards.html

Beneficiaries:

As helmets are one of the most important parts of protective equipment, the standards ensure that they are able to protect the helmet wearer in the case of a crash. By contrast, a helmet that is not certified is most likely not able to offer any protection to the wearer in the event of an accident. Hence, standards certifying the quality of this protective equipment are beneficial for PTW riders as helmets improve the rider’s safety.

Figure 59: Helmet certified to ECE 22.05 standard [53]

Clear definition of the problem

If no standards for motorcycle helmets exist, PTW riders cannot rely on their own helmet as they do not know if their helmet will offer any protection to them in the event of an accident. They cannot be expected to be able to assess quality themselves.

Size of the problem, Scientific Background

Wearing a motorcycle helmet correctly can reduce the risk of death by almost 40% and the rist of severe injury by over 70% (Liu B. et al, 2005).

[53] Source: http://www.motoin.de/images/product_images/original_images/held-heros-jet-helm-schwarz-orange-5475_0.jpg, 29 Sep.2010

Requiring helmets to meet a recognized safety standard is important to ensure that helmets can effectively reduce the impact of a collision to the head in the event of a crash.

Motorcycle helmets reduce head injuries sustained by PTW riders by almost 50%. Injury accidents are reduced by 25%. It may be assumed that such a good level of protection can only be achieved by high quality helmets fulfilling a certain standard. However, there were no figures found about protective level of helmet of inferior quality.

Expected impact

The 2009 WHO survey found that 74% oft he participating countries had obligations for helmet use in place, however, in 43% oft he countries, there was no obligatory helmet standard.

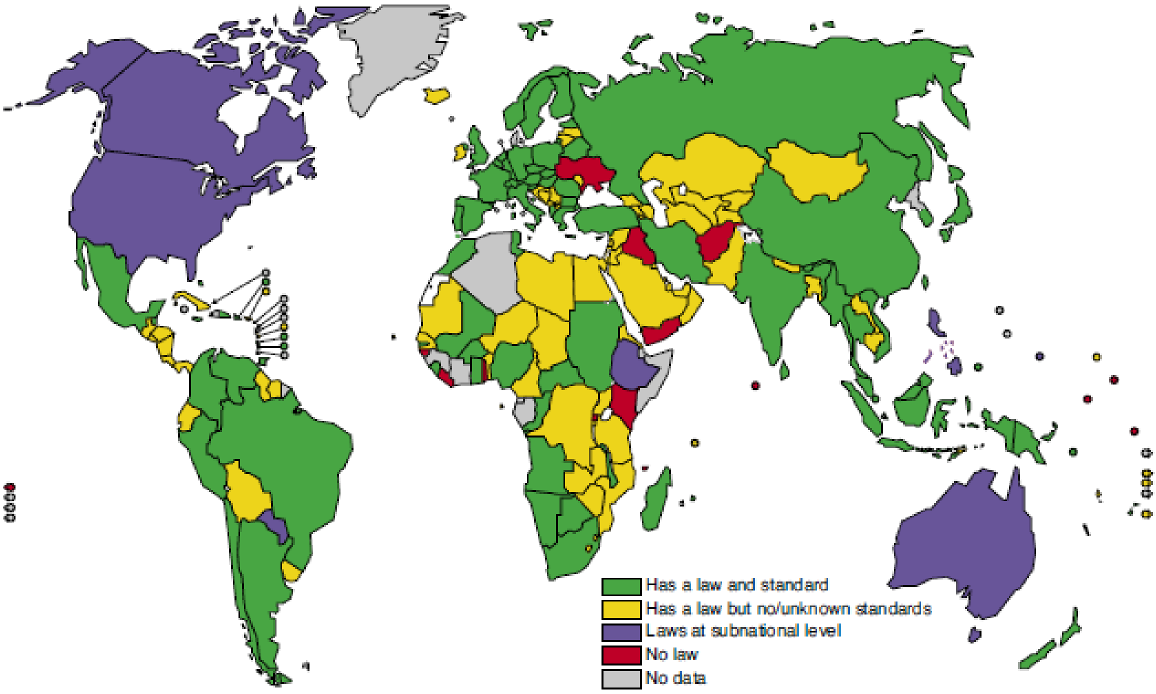

Figure 60: Motorcycle helmet laws and helmet standards by country/area 54

Implementation

This has to be implemented by an obligation to the manufacturers and dealers. Campaigns should support he implementation to raise acceptance. Enforcement of the measure has to be considered. There is a sufficient number of such standards available.

Acceptance

Obligatory helmet wearing is an issue in many countries, strongly objected by groups of riders. However, rider implementing a standard does not affect riders directly else than, if the purchase a helmet, the get a safe one. Acceptance has to be raised at the political level.

Sustainability

It is unlikely that effects would fade.

Transferability

New standards can be applied anywhere.

[54] Source: WHO world report in traffic safety, 2009, p. 23.

Costs and benefits

Elvik and Vaa (2004, pp 663 ff) estimates benefit-cost ratio of PTW helmets to be 17 (+/- 6). These values will unlikely be achieved, if there are no standards in place for safety of helmets.

Riders' perspective

★★★★☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

I may be assumed that mandatory use of helmets should receive utmost attention. This should not be done without defining safety standards at the same time.

Obligatory Helmet Use for PTW Riders and Passengers

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★★☆

This measure involves that both PTW riders and passengers should were a proper helmet. Properly fastened and officially approved protective helmets account a lot for PTW riders' and passengers' safety.

Examples:

The Czech Republic defines in the Act on the road traffic that, when riding a motorcycle or moped, an approved helmet must be put on and fastened properly.

Also the Portuguese Highway Code says that motorcycle riders must wear an officially approved protective helmet. To encourage the proper helmet use, the Highway Code says that the helmets must be fastened securely.

http://www.prp.pt/informacao/actualidades/act_00107.asp

The UK Highway Code says that on all journeys, the rider and pillion passenger on a motorcycle, scooter or moped must wear a protective helmet. This does not apply to a follower of the Sikh religion while wearing a turban. Helmets must comply with the regulations and they must be fastened securely. Riders and passengers of motor tricycles and quadricycles should also wear a protective helmet.

Department for Transport (2007). The Official Highway Code, p.24

The Australian Road Rules say, that the rider of a motor bike that is moving, or is stationary but not parked, must wear an approved motor bike helmet securely fitted and fastened on the rider's head and must not ride with a passenger unless the passenger is also wearing an approved motor bike helmet securely fitted and fastened on his head (Rule 270).

http://www.ntc.gov.au/ViewPage.aspx?documentid=00794

In Greece, helmet use is also obligatory for motorcycle, moped and three wheeler vehicle drivers but in some cases, people are excepted from this responsibility.

In Spain, a federal road safety law came into effect in the autumn of 1992 extending the compulsory use of approved safety helmets for motorcycle riders and passengers to urban areas.

Beneficiaries:

The measure is beneficial for PTW Riders as helmets improve the rider's safety. The overall guidelines mostly target the PTW rider injury severity. Considering the huge impact on PTW safety, it has to be considered that crash helmet were proven to be highly cost effective, hence, the impact to all people in terms of macroeconomic crash costs has to be considered. All people benefit from reductions of crash costs.

Clear definition of the problem

Due to lack of separation between the PTW riders and passengers and the road environment in several accidents the injuries involve head injuries. These could be less severe if a proper helmet is used.

Expected impact, Scientific Background, Size of the problem

Wearing a motorcycle helmet correctly can reduce the risk of death by almost 40% and the risk of severe injury by over 70% (Liu B. et al, 2005).

By reasonable enforcement, helmet usage rate can be raise about 90% (Kaus et al, 1992; Servadei et al, 2003).

Motorcycle helmets reduce head injuries sustained by PTW riders by almost 50%. Injury accidents are reduced by 25%. It may be assumed that such a good level of protection can only be achieved by high quality helmets fulfilling a certain standard. However, there were no figures found about protective level of helmet of inferior quality.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

Implementation

There are no critical issues to be considered in implementing it – just enforcement might be needed in countries where riders are not so obedient (usually South Europe due to rider mentality and high temperatures). Awareness campaigns should flank implementation.

Acceptance

Experience has shown the riders sometimes strongly disagree, considering a helmet obligation an intervention to the human rights.

Sustainability

A helmet obligation is just as effective as it is enforced.

Transferability

Implementation of this measure is possible anywhere. The measure will/is be less effective in countries where riders do not obey the rules, which is not uncommon in countries with high temperatures. However, this could be dealt with more police enforcement.

Costs and benefits

Elvik and Vaa (2004, pp 663 ff) estimates benefit-cost ratio of PTW helmets to be 17 (+/- 6). These values will unlikely be achieved, if there are no standards in place for safety of helmets.

Riders' perspective

★★★★☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

According to all evidence and expert opinions, this should receive utmost attention.

Standards for Eye Protection

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★☆☆☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★★★☆☆
Efficiency	★★★☆☆	Sustainability	★★★★★

Goggles or safety glasses are forms of protective eyewear that usually enclose or protect the area surrounding the eye in order to prevent particles (e.g. insects, dust, small stones) from striking and damaging the eyes. The standards for motorcycle helmets ensure that the safety glasses are able to protect the wearer in the case particles are hitting the glasses.

Example:

The EN 1938 is a European Standard and it defines the requirements and the testing methods for goggles used by motorcycle and moped riders used on the streets and in the terrain. Goggles used in official racings or tournaments are excepted. It is already implemented in national Standards such as DIN EN 1938 (Germany) or OENORM EN 1938 (Austria).

http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_12515.html

Beneficiaries:

The measure improves the pan-European harmonization of standards and provides an equal safety level of goggles.

Figure 61: Goggles for motorcycling[55]

Clear definition of the problem

Building on the arguments for obligatory use of eye protection, it is, like for any technical obligation, necessary to define technical criteria which clearly define how the obligation can be followed. Consumer protection demands that devices sold for protection should fulfil the purpose to a predefined extent.

Size of the problem, Scientific Background, Expected impact

No evidence could be found quantifying the problem.

Evidently, the measure will have a safety impact. PTW single vehicle collisions and collisions with all kinds of other road users may be prevented by an unknown extent.

Implementation

Such a standard would mainly address equipment manufacturers. But also dealers would be concerned, who should only sell approved equipment.

[55] Source: http://www.safetyglassesusa.com/molego.html#paging, 18 Aug. 2009

In some countries, cooperation between different administrative bodies might be affected, since mandatory implementation of such a standard might affect both traffic law and consumer protection. Enforcement needs to be considered.

Acceptance

Normally such standards are beneficial for the market, safety issues will be excluded from competition. Inferior equipment would be excluded from the market.

Sustainability

It is unlikely that effects would fade.

Transferability

New standards can be applied anywhere.

Costs and benefits

Neither the costs nor the benefit can clearly be quantified for the time being.

Riders' perspective

★★★★★

Helmet use is already mandatory in Europe for all PTW users and with a compliance rate of over 99%, the riders' associations consider that changes in the law are not needed.

Priorities

Although there is no evidence displayed about the impact, benefits are obvious and the measure receives high ratings by experts.

Eye Protection Regulations

Expert Assessment			
Overall		★★★☆☆	
Size	★☆☆☆☆	Transferability	★★★★★
Total impact	★☆☆☆☆	Implementation	★★★★★
Safety impact	★★☆☆☆	Acceptance	★★☆☆☆
Efficiency	★★★☆☆	Sustainability	★★★☆☆

Eye protectors like glasses, goggles, shields or visors can improve the rider's safety, especially concerning the case of stone chipping, but these protective devices must be clean, good fitting and in good condition (no scratches). In some weather situations (e.g. rainfall, snowfall) it is better not to use them.

Examples:

The Czech Act on the road traffic implies an obligation for protecting the rider's eyes with appropriate manner (e.g. glasses, shield) for motorcycle and moped drivers if using them in specific weather situation does not limit safe driving.

In the UK, wearing eye protectors is advisable but not mandatory. The Official Highway Code says that the eye protectors must comply with the regulations and it reminds the riders that scratched or poorly fitting eye protectors can limit the view when riding, particularly in bright sunshine and the hours of darkness.

Department for Transport (2007). The Official Highway Code, p.24

Beneficiaries:

The measure is beneficial for PTW Riders as lapse of concentration due to poor visibility and injuries caused by stone chipping can be avoided.

Clear definition of the problem

Especially at high speed, particles (e.g. small stones, insects) hitting a rider's eye would immediately prompt the rider to close his eyes instinctively and prompt (both) eyes starting to water. The rider would be more or less blind being likely to fall, hit an obstacle or another road user.

Size of the problem, Scientific Background, Expected impact

No evidence could be found quantifying the problem.

In case, eyes are protected, only massive objects will remain as a problem, if they damage of penetrate the protective device.

The measure is likely to reduce PTW single vehicle crashes as well as collisions with other road users.

Implementation

This has to be implemented by an obligation to the riders.

Campaigns should support he implementation to raise acceptance.

Enforcement of the measure has to be considered.

Acceptance

It may be expected that riders do not welcome another obligation puit on them, even if it is mainly for their own sake. Implementing mandatory wearing of eye protective devices might face similar resistance to helmet wearing.

Sustainability

It is unlikely that effects of wearing would fade. Proper enforcement of an obligation will be key to ensure a sustainable effect.

Transferability

Basically, there are no barriers to implementation except potential resistance by riders.

Costs and benefits

No data available.

Riders' perspective

☆☆☆☆☆

The riders' associations object to making this measure mandatory because it infringes on the freedom of road users. Most helmet designs come with a visor, and safety-conscious riders already rely on their judgment to decide when their comfort and safety requires using the appropriate eye protection.

Priorities

In most of the cases within this volume, obligatory use of protective devices receives higher ratings from experts than technical standards on such devices. For eye protection it is contrary. Nevertheless, there are clear and obvious reasons for obligatory use of eye protection.

Protective Gloves (for Professional Motorcycle Riders)

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★★★☆
Total impact	★☆☆☆☆	Implementation	★★★★★
Safety impact	★☆☆☆☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★★

Protective Gloves can improve the rider's safety as they protect against open lesions and bad skin abrasions in the event of an accident. For professional motorcycle riders they should be a mandatory part of the working garment.

Example:

The EN 13594 is a European Standard and it defines the requirements for protective gloves concerning size, ergonomic attributes, innocuousness, mechanical characteristics, cleaning, labeling and the user information to be supplied. Furthermore, the testing methods for checking these requirements are characterized. It is already implemented in national standards such as DIN EN 13594 (Germany) or BS EN 13594 (UK).

http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_10882.html

Beneficiaries:

The measure improves the pan-European harmonization of standards and provides an equal safety level of protective gloves.

Figure 62: Protective gloves[56]

Clear definition of the problem

The hands of the rider play an important role for example when falling off a motorcycle. By instinct of self-protection hands will be used to absorb the impact energy and they are therefore especially exposed to injuries. That is why a good protection of the hands in case of a fall with protective gloves plays a vital role. In addition, they must also guarantee a maximum of grip, of control on the handlebars and switches and the clutch and brake levers.

Different material can be used for protective gloves, e.g. leather, cordura, Kevlar or a combination of materials. Some include carbon filter knuckle protection or other forms of rigid padding, e.g. hard-plastic parts, additional reinforcement on finger joints to avoid burn injuries, etc.

Usually motorcycle gloves need to have slightly pre-curved fingers, often with the seams on the outer surface of the gloves in order to guarantee an optimum of grip and handling.

Size of the problem

The use of protection equipment is recommended for each ride, therefore this is an important issue of rider's safety.

Scientific Background

Gloves need to be outfitted with hard plastic parts on probable contact areas in order to ensure maximum protection in case a motorcyclist touches the ground: the gloves (and motorcycle clothing) must permit him to slide easily instead of “crumbling” where the risk to injure body parts being stressed in abnormal directions is particularly high. Hard plastic/leather parts furthermore need to protect riders form e.g. burn injuries

[56] Source: http://www.cbxmanmotorcycles.com/Icon-Mens-Merc-Riding-Gloves-Long-Red.aspx, 18 Aug. 2009

Implementation

- Gloves need to protect hands from falling on the ground, from rain, low temperatures, sun etc.
- Gloves need to be adequately sized and comfortable otherwise they have a negative impact on driving performance, handling of the bike, ability to protect and therefore on the safety of motorcycle riders.
- Better information needs to be provided on e.g. choosing the right size, the use of the gloves, under what conditions, the protection level needed, etc.
- Gloves should not be unhandy and too thick and should be full-fingered – otherwise operation of the controls, handlebars, etc. will be negatively affected
- Cloves shouldn't be too heavy otherwise riders won't buy them
- Consider material and its protective needs to guarantee optimal protection
- Protective Gloves shouldn't be too expensive
- The best possible gripping (e.g. using materials such as silicon for the palm of the gloves) needs to be guaranteed by protective gloves.
- Consider different gloves for different motorcycle types (Motocross vs. Racing, etc.)
- Consider different terrains where gloves need to protect (e.g. Motocross: soft terrain, cruisers: asphalt, etc.)
- Consider different weather conditions (southern countries vs. northern countries, summer vs. winter): gloves e.g. in winter need to combine optimally protection and comfort
- Adequate and anti-slipping material used for gloves improve grip on the handlebars and therefore improve safety of riding a motorcycle.
- Research showed that riders were generally positive about wearing motorcycle protection gloves but mentioned critique when it comes to price and weight of the gloves.
- Define common EU-Standards for the production and use of protective gloves
- Accelerate and improve research on protective potentials of different material used for protective gloves.
- Provide more Information to the riders: e.g. which gloves to use for which situation, for which motorcycle, etc.

Expected Impact(s)

Elvik and Vaa (2004, p 565) mention a study which estimated protective gloves to redude hand inkuries by 50%.

The MAIDS report (AVEM, 2009, p126) indicates that hands were affected in at least 57% of PTW crashes, in 43% of all cases, glovers either prevented or reduced severity of hand injury. in 2.3% of the cases, hand protection was found to be irrelevant.

Acceptance

As for use of other protective equipment, riders might be reluctant to accept an intervention to making their own decision whether to use gloves or not. Industry might be reluctant to accept technical standards but may be assumed to be in favour obligatory use, which will increase their sales. Willingness of police forces to enforce the measure is an issue in case of mandatory use.

Sustainability

This measure can be considered as sustainable, as riders who are used to wear protective equipment will use gloves for each trip.

Transferability

This measure can be transferred to other countries. The acceptance of riders might decrease in southern European countries because of warmer weather conditions.

Costs and benefits

The use of protective gloves provides a high benefit as hands will be used to absorb the impact energy and are exposed to injuries.

Riders' perspective

★★★☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

There is clear evidence for a strong protective impact of the use of protective gloves for PTW riding, which is somehow in contradiction with the expert ratings, which show high rating within the "administrative" parts and low ratings on impact and efficiency.

Impact Protectors for Motorcyclists

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	★★★☆☆
Total impact	★☆☆☆☆	Implementation	★★★☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★★☆☆	Sustainability	★★☆☆☆

Impact protectors are part and parcel of protective clothing and can minimize the risk of injury of PTW riders and passengers in case of an accident. The two most important impact protectors are for the back and for the legs.

Example:

Part 1 of the EN 1621 defines general requests for impact protectors which are usually part of jackets, trousers and one-piece or divided suits for motorcyclists. It also defines the requirements for the material they are made of and the way they are fixed on the clothes. In the second part, the minimum part of the back covered by back-protectors is defined. The standard also contains requirements concerning the performance of them and defines the test methods for these protective devices.

http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_12112.html

Beneficiaries:

The measure is beneficial for PTW riders as impact protectors can prevent injuries in case of an accident. The overall guideline is targeted on the PTW rider injury severity.

Figure 63: Impact protectors for the back and legs[57]

[57] Source: http://www.spokes.com.au/assets/protective-clothing/armour.jpg, 21 Sep. 2010
http://www.beginnerbikers.org/showthread.php?27315-Sensible-knee-protection-!/page3, 29 Sep.2010

Clear definition of the problem

Motorcyclists do not have a protective carriage and therefore their body is exposed to collisions with other vehicles, obstacles or downfall.

Size of the problem

Impact protection is an important element in protecting the body in a collision or downfall.

Scientific Background, Expected Impact(s)

The safety benefit of impact protectors in high impact crashes is rather but they may reduce the severity of an injury (e.g. simple fractures instead of complex fractures). Impact protectors may also prevent some apparently minor injuries such as chipped elbow, shoulder or knee bones, which can be more debilitating and require longer rehabilitation than fractures (Otte et al., 2002). Impact protectors work by slowing down the rate of transfer of the forces in an impact to a less damaging or non-damaging level (impact attenuation)

In order to be effective however, it is essential that impact protectors are fitted and held in place so that they will not move during a crash.

Two European Standards for motorcyclist’s impact protectors exist: shoulder protectors and the other for back protectors limb and shoulder protectors (EN 1621-1) and Back protectors and lumbar protectors (EN 1621-2)

Implementation

- Barriers to implementation: Weight, costs and comfort of impact protectors
- Awareness raising: By promoting safety benefits of impact protectors to motorcycle riders.

Acceptance

Evaluations in 2BESAFE (e.g. Focus Group Interviews): riders were rather positive towards impact protectors but stated concerns when it comes to weight, costs and comfort.

The rider population seems to be split into two groups: Some are in favour of protective equipment; those are likely to buy the best that is available, even disregarding major investment. The other group is not in favour of using protective equipment.

In central Europe it seems that recreational riders follow a trend to more and more "celebrate" their hobby, which also includes having the best equipment available on the market, which is, as a matter of course, fitted with protectors.

Sustainability

Once a rider is convinced about the benefits of protective equipment, the impact may be considered sustainable. However, riders might take higher risks if they feel well protected by the dress they are wearing. Rider might takes shorted trips without their protective devices.

Transferability

Protective clothing fitted with protectors and protectors themselves can be sued anywhere around the globe. Convincing riders to use this equipment might be more difficult in low- and medium income countries.

Costs and benefits

There are several studies available indicating the positive impact and efficiency of PTW riding, e.g. the MAIDS report (ACEM, 2009) and The Handbook of Road Safety Measures (Elvik et al, 2009).

Riders' perspective

★★★☆☆

The riders' associations support standards for impact protectors because they ensure products offered for sale as meet minimum requirements for quality and safety.

Priorities

Although there is clear evidence for the impact of the measure, experts rate it rather low for most of the criteria. Wearing separate impact protectors might be futile if other reasonable protective equipment is used. Hence, there might be application only in small area. Such protects might be particular considered, where use of protective jackets and pants is unsuitable from climate reasons.

Protective Footwear (for Professional Motorcycle Riders)

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★★★☆☆
Total impact	★☆☆☆☆	Implementation	★★★☆☆
Safety impact	★★☆☆☆	Acceptance	★★☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★☆☆

Protective footwear can improve the rider's safety as they protect against skin abrasions and wounds on the feet and lower legs. Additionally, high and approved boots will, to a certain degree, protect against breakages to feet, foot joints and the lowest part of the shin bone. Thus, protective footwear should be a mandatory part of the working garment for professional motorcycle riders.

Example:

The EN 13634 is a European Standard and it defines the requirements concerning protective function, ergonomic attributes, innocuousness, mechanical characteristics, cleaning, labeling and the user information to be supplied. Furthermore, the testing methods for checking these requirements are characterized. It is already implemented in national standards such as DIN EN 13634 (Germany) or BS EN 13634 (UK).

http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_10954.html

Beneficiaries:

The measure improves the pan-European harmonization of standards and provides for an equal safety level of protective footwear.

Figure 64: Protective footwear[58]

Clear definition of the problem

Professional motorcycle riders have a higher exposure to accident risks. Protective footwear can reduce accident severity.

[58] Source: http://www.ghostbikes.com/products/1002-swift-torsion-x-motorcycle-race-boots-.html, 29 Sep.2010

Size of the problem, Scientific Background

According to the results of MAIDS (ACEM, 2009) injuries to the lower extremities are recorded in 31,8% of accident cases. Protective footwear has the potential to reduce accident severity in such cases.

Expected impact

Measuring the impact of the measure is problematic due to the fact that protective footwear is a secondary safety equipment, reducing the risk of injury and potentially injury severity. Qualitative analysis of accident-related injuries can help measure the efficiency of the measure.

Adverse effects: mandating the use of protective footwear for professional motorcycle riders may cause some riders to purchase and use equipment that is not adapted to their needs or activity. Protective equipment, in all cases, must not cause undue discomfort, which in turn may lead to premature exhaustion, overheating, which can all be a cause of distraction and impaired ability. In particular, the use of heavy equipment can be problematic in hot environments.

Implementation

Implementing the mandatory use of standard-compliant protective footwear will require extensive consultation with organizations and employers of professional riders (the latter includes police forces), in order to ensure that the standard fits their needs and that the measure matches an existing demand.

In addition, an impact assessment on the cost-effectiveness of the measure as well as a review of the standard's soundness should be conducted prior to enacting legislation.

Acceptance

As for use of other protective equipment, riders might be reluctant to accept an intervention to making their own decision whether to use protective footware or not. Industry might be reluctant to accept technical standards but may be assumed to be in favour obligatory use, which will increase their sales. Willingness of police forces to enforce the measure is an issue in case of mandatory use.

Sustainability

The measure is regulatory, and being targeted at professionals, would not face fading effects.

Transferability

If the effectiveness of the measure is proved, it can be easily transferable if the professional motorcyclist community is supportive. Issues with the climate (see above) have to be considered when applying the measure to other countries.

Costs and benefits

According to Elvik et al, 2009, protective footware can be expected to reduce injury by 33%. All together, the study estimates a benefit-cost ratio of 5.3, but does not provide separate figures on protective footware.

Riders' perspective

★★★★★

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

Although riders sustain more injuries on lower than upper extremities, the experts rate protective boots lower than gloves. Efficiency figures clearly recommend use of protective boots.

Neck Braces

Expert Assessment			
Overall		★☆☆☆☆	
Size	★☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★☆☆☆☆

Modern motorcyclists have a great range of choices when it comes to helmets, body armor, back protectors, etc., but choices in neck protection systems have so far been limited. Nevertheless, neck braces are one of the most important parts of protective equipment as they prevent severe or even fatal injuries: Helmet impacts otherwise transmitted from the helmet to skull and then to the neck are re-directed from the helmet to the brace to other body structures in a safe way. Thus, neck braces are designed to bring the head to a gentle stop in the event of a crash which will minimize the possibilities of the injuries caused by extreme (forward/ rearward/ sideways) movements of the head.

Example:

One of the most popular neck brace system on the market today is the so-called “Leatt Brace”. It is placed on the motorcyclist’s shoulders and is designed to limit the extreme range of movement his head might be forced to make during a crash. It is not connected to the helmet in any way but provides a solid surface to stop helmet motion, preventing damage to the spinal cord and vertebra from extreme forward, rearward, lateral or downward forces.

http://www.leattbrace.org/index.php

Beneficiaries:

The measure is beneficial for PTW riders as neck braces can prevent injuries in case of an accident. This is importance because neck injury affects almost one in ten rider casualties.

http://www.roadsafety.mccofnsw.org.au/a/91.html

Figure 65: KTM Leatt Brace[59]

Clear definition of the problem

PTW riders suffering from neck injuries caused by the forces of an accident.

Size of the problem

This measure is of importance because neck injuries affect almost one in ten rider casualties.[60]

Scientific Background

The MAIDS (motorcycle accident in-depth study) found 1,1% of riders sustaining neck injuries and 5% sustaining spine injuries.

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[59] Source: http://news.motorbiker.org/blogs.nsf/dx/10112006132703MWEFFH.htm, 21 Sep. 2010
[60] Source: http://www.roadsafety.mccofnsw.org.au/a/91.html, 27 Nov. 2011

Expected impact

- Reduction of neck- and spinal cord injuries.
- Side effects, could - like for any other protective equipment - occur by increased risk-taking behaviours.

Implementation

As a precondition for mandatory implementation, technical standards for testing the protective effect would be needed. Campaigns or funding could be used to improve usage rates on a voluntary bases.

Acceptance

It may be expected that riders do not welcome another obligation put on them, even if it is mainly for their own sake. Implementing mandatory wearing of eye protective devices might face similar resistance to helmet wearing.

Sustainability

It is unlikely that effects would fade.

Transferability

Basically, there are no barriers to implementation. Mandatory implementation would face resistance by riders almost everywhere.

Costs and benefits

Neck braces were found between 200 and 450 Euros. Financial benefits cannot be estimated since statistical information on effectiveness is not available. Accident rates of the particular target group would have to be considered.

Riders' perspective

★☆☆☆☆

The riders' associations support communication campaigns aimed at educating riders about the benefits of neck braces and other protective equipment in general. However, neck braces are most beneficial for certain riders in certain circumstances, and do not answer the safety needs of all users, such as some urban motorcycle and scooter riders.

Priorities

Scientific evidence and experts rating suggest that other protective equipment should receive more attention.

Airbag Jackets

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★★☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	☆☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★★☆

Upon detection of a crash situation, the airbag jacket is automatically deployed to minimize the injury to the rider. Although airbag jackets involve the same principles as vehicle-mounted airbags, there is a difference concerning the time of activation: Rather than trying to prevent the motorcyclist from being thrown from the vehicle, airbag jackets come into effect once this has happened. The jacket is connected to the vehicle via a cable, and when this connection is interrupted the airbag inflates. The rider will still hit the ground with the same force, but he will be protected with a cushion of air surrounding his upper body.

Example:

There are a number of commercially available airbag jackets (e.g. Hit-Air, MotoAir, Dainese). But so far, there is no existing independent evaluation concerning their effectiveness.

Beneficiaries:

Airbag jackets are passive systems which serve to reduce injury severity. In addition to front-impact crashes, airbag jackets could be effective in a range of loss of control or multiple vehicle crash where the rider is thrown from the vehicle.

Figure 66: Airbag jacket[61]

Clear definition of the problem

Airbag devices can be live-saving in situations where riders are not able to protect themselves anymore e.g. accidents occur in a very short time and riders are not able to react in time.

Size of the problem

Problem concerns crashes where the motorcycle rider is thrown from the vehicle (on the ground or travelling into another vehicle)

Scientific Background

When it comes to motorcycle airbags one has to differentiate between Airbags which are mounted on fuel tanks of the motorcycle (such as the “Honda Goldwing” model provides, which has proven very beneficial during especially frontal collisions: protection of the rider from the impact by taking away the force of the rider, prevention of the rider from traveling into the oncoming vehicle, reduction of the a rider’s velocity and his/her trajectory, reduction of head traumas, etc.) and wearable jacket airbag devices.

With inflatable airbag jackets one has to further distinguish between models where the jacket is connected to the vehicle through a cable (when this connection is severed the airbag inflates) and more recent ones with a built-in computer chip (if chip detects a collision, the jacket will then self-inflate) which is currently used by “Dainese” (www.dainese.com) but so far only in the racing environment).

To the motorcycle tethered jackets fully inflate themselves automatically within a few seconds (by a carbon dioxide cylinder built into the jacket) when the rider is thrown from the bike.

Generally very few scientific tests and independent evaluation of airbag jackets have been done so far. Tests of the airbag jacket maker “Hit Air” have shown, that the airbag jackets proved additional safety benefits to normal Airbag Jackets and significantly reduced upper body and internal injuries (see “Trace project”, www.hit-air.com, www.eggparka.com).

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[61] Source: http://origin-images.ttnet.net/pi/eto/10/21/03/70/10210370-1t.gif, 20 Jul. 2010

Implementation

- Research has shown that riders are willing to buy such a jacket if the prices are adequate. They would only wear it under weather conditions that allow to wear such a jacket (additional weight).
- Airbag jackets do not prevent the rider from hitting the ground. The rider still hits the ground with the same force, but he/she will be protected with a cushion or air surrounding their upper body.
- Generally the communication of the safety benefits of airbag jackets needs to be improved in order to encourage motorcycle riders to buy such safety equipment.
- Research on safety benefits and the development of lighter and less expensive Airbag Jackets needs to be fostered and pushed forward.
- Common EU-Standards for the production and implementation of Airbag Jackets need to be defined.

Expected impact

The use of inflatable Airbag Jackets will have a positive impact on motorcycle rider safety and will decrease the risk of heavy injuries to the rider. Motorcycle airbag jackets provide protection to the neck, chest, back, shoulders, hips, bottom and spine of the PTW-rider.

Acceptance

Riders are principally willing to buy such a jacket if the prices are adequate and the weight is not too heavy. Further, riders might not be willing to wear airbag jackets at every time of the day or the year (warm weather might deter motorcycle riders from wearing additional protective equipment).

Sustainability

The measure is principally sustainable and no major risk of fade is to be expected.

Transferability

As injuries caused by falling off a motorcycle is a wide-ranging issue, the usage of airbag jackets is useful in all European countries (both in rural and urban areas) and for all types of motorcycles. The measure is transferable in all European countries.

Costs and benefits

No cost-benefit figures can be provided. However, motorcycle jackets are relatively expensive (e.g. motorcycle jackets from “hit-air” cost around 500 €)

Riders' perspective

★★★★★

The riders' associations support communication campaigns aimed at educating riders about the benefits of airbag jackets and other protective equipment in general. Airbag jackets are increasingly popular in several European countries, and the technology is rapidly improving (e.g. wireless activation, shorter response time), potentially offering a better avenue for safety than on-vehicle airbags.

Priorities

Moderate priority is to be given to this measure as the acceptance of motorcycle riders to wear such jackets is rather low. In addition, scientific investigation on the safety benefits of airbag jackets is not very advanced so far and market penetration of Inflatable Airbag Jackets is still very low.

11. Driver Education and Licensing

11.1. Licensing, Basic Training

Legal Regulations for Obtaining a PTW Riding License

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★★★
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★☆☆☆☆
Efficiency	★★★☆☆	Sustainability	★★★☆☆

This measure involves the legal regulations for obtaining a PTW riding license, including regulations defining characteristics of those who can obtain a license, different classes of licenses considering different access criteria, criteria for having the license detracted and regained etc, so as obtain a quality assurance of the candidate's basic skills and knowledge, which is given by the minimum skills and knowledge needed to safely operate a motorcycle on public roads.

Examples:

The Austrian driving law called FSG (Führerscheingesetz) contains the regulations of licenses for all classes. It constitutes who is allowed to acquire which license and under which circumstances as well as how the practical and the theoretical exam should look like. Furthermore, it describes the consequences of disregarding the rules. It is a national guideline, implemented 2008 by the Federal Ministry for Transport, Innovation and Technology (BMVIT) of Austria.

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10012723

By 2013, the Third European Driving License Directive should be implemented in each Member State of the European Union and replace Directive 91/439/EC. This Directive will introduce an overly complex license structure for young and new riders. It could contribute to further enable the mobility contribution of PTWs, while at the same time improve the safety of their users. It seeks to harmonize motorcycle licenses across Europe but nevertheless, Member States can: encourage progressive access, also through the use of equivalences with car license for lower categories of PTWs, develop training (pre-license; in progressive access; for equivalences), all within a lifelong learning approach seeking to improve the attitude of both riders and drivers, to the benefit of improved road safety for all road users, in particular vulnerable road users. The document will be renewable every 10 or 15 years depending on the member state.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006L0126:EN:HTML

Each state and territory in Australia has its own licensing laws, which include laws relating to the licensing of motorcyclists.

http://australia.gov.au/topics/transport/registration-and-licences

The driving license test should not be restricted to checking the candidate's knowledge of the or his ability to carry out maneuvers. As mentioned in the policy orientations up to 2020, the European Commission will consider how to also include broader driving skills, or even an evaluation of values and behaviour related to road safety (awareness of the risks) and defensive, energy-efficient driving (reinforcement of the key elements of eco-driving within the curricula of the theoretical and practical tests).

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.5

Beneficiaries:

Those regulations are addressed to PTW riders and aim at a decrease of accident numbers.

Clear definition of the problem

One of the highest risk groups are novice motorists, hence a more thoroughly designed framework of the legal regulations for obtaining a PTW riding license is needed. This should be tailored-made according to the different issues of the different countries.

Size of the problem

Rider inexperience (even without considering rider age) is one of the most important risk factors.

Scientific Background

There are reports that indicate a positive impact of for example graduated license models.

This measure shall work as the legal regulations will become more detailed and tailored-made for the needs of each country. Rider training is quite important and should be treated in this way.

The measure targets the identified problem to a high extent.

Expected impact

Legal obligation for acquiring a driving license target accidents where novice riders are involved and have in many cases proven to be effective.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

Implementation

There are no barriers for implementing the measure, however know-how obtained from different countries might not be suitable for one country as these regulations should concern the exact needs of the different riders. Redesigning regulations is rather difficult and this can be another barrier.

A critical issue before implementing the measure is to be certain that the new regulations “make sense” according to accident data, however, without constraining rider mobility to a high extent. Another critical issue is to consider how to treat the novice riders who took their license under the previous law.

The legal regulations should be compatible between them, coherent and easy to follow.

Acceptance

This "measure" covers a lot of different activities and regulations. In general, PTW riding is well accepted as a task which requires comprehensive knowledge about traffic rules, vehicle technology and driving dynamics as well as a reasonable level of skills. Educating and testing of riders is well accepted, wherever it is done.

It has to be noted that there are various interest groups concerned like riders' associations, industry and educational bodies. Changes to the licensing system integrating the interests of all these groups may be difficult, time consuming and they are sometimes subject of various political interests instead of simple transfer of scientific evidence into legal provisions.

Sustainability

Educational measure were frequently found to have an effect only to s rather short period after licensing. Hence, licensing schemes should particularly aim at achieving sustainable effects. However, it has to be noted that even if the effects are limited to a short period, this period is considered to be the most dangerous one within the career of a rider.

Transferability

If the regulations are tailored-made for each country then the measure will have more or less the same effects in the different countries.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★☆

The riders' associations support licence schemes that focus on teaching the necessary skills to survive on the road, including traffic interface, machine control and attitude and behaviour. Licencing schemes that focus only on the traffic code, or on mastering the skills needed to pass the test, offer little value and should be avoided.

Priorities

A comprehensive system of licensing and surrounding measure is in place in Europe and received significant changes by the 3rd Driver License Directive. Current priority should be given to evaluating the effects of this new law. It may be derived from the evidence above that nobody should be allowed to use a PTW without proper education.

Graduated Licensing

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★★★☆
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	☆☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	☆☆☆☆☆

Graduated Licensing Programs are designed to help to reduce crashes through restrictions in the first months/years of riding. The graduated licensing schemes combine power restrictions of the vehicle with age limitations. Riding is especially risky when one lacks in experience as a new rider. Therefore, more-stage-programs were designed to help inexperienced riders becoming safe riders for life — and reduce their risk of crashing while learning. Before obtaining a full motorcycling license, the candidates have to prove basic theoretical and/or practical skills.

Examples:

In Ontario, all new drivers applying for their first car or motorcycle license enter Ontario's Graduated Licensing System (GLS). The two-step licensing process takes at least 20 months to complete. To apply for a license, people must pass a vision test and a knowledge test concerning the rules of the road and traffic signs. After passing these tests, one can receive a Class M1 license. New motorcycle riders with a Class M1 license learn to ride under these four conditions:

- blood alcohol level must be zero;
- they must ride only during daylight hours (1/2 hour before sunrise to 1/2 hour after sunset);
- they must not ride on highways with speed limits of more than 80 km/h (with exceptions);
- they must not carry passengers.

After passing the M1 road test or completing an approved motorcycle safety course, people can obtain a Class M2 license 60 days after receiving the M1 license. The Class M2 license must be held for a minimum of 18 months. With an M2 license, the riders gain more privileges – they may ride at night and on any road. A further and much more comprehensive traffic-management skills test qualifies the candidate to proceed to the M license, which is unrestricted and permanently valid.

http://www.mto.gov.on.ca/english/dandv/driver/gradu/index.shtml

In Victoria, Australia, one must hold a learner permit continuously for at least three months in the period immediately prior to obtaining a motorcycle license. To get this permit, following tests need to be passed:

- road law knowledge test
- motorcycle knowledge test
- motorcycle skill assessment (a practical test)
- eyesight test

Learner permit holders can ride a motorcycle when they display their 'L' plate on the back of their scooter or motorcycle and they must not tow a trailer behind their motorcycle. To be eligible to obtain a motorcycle, following tests are required after having a motorcycle learner permit:

- eyesight test
- motorcycle license skills assessment (a practical ride)
- hazard perception test (not required if the rider has already a car license)

A person issued with a motorcycle license for the first time will have the following restrictions placed on their license for 12 months from the date the motorcycle license is issued:

- If the motorcycle license was issued before 1 July 2008, the driver may ride any motorcycle not exceeding 260cc or any Learner approved motorcycle.
- If the motorcycle license was issued on or after 1 July 2008, the driver may only ride any learner approved motorcycle (There is an approved list of motorcycles for novice riders).
- The driver must not ride a motorcycle while carrying a pillion passenger (a motorcycle and sidecar is acceptable with a passenger)
- The PTW rider must have a zero blood alcohol content (BAC) when riding a motorcycle

http://www.vicroads.vic.gov.au/Home/Licences/

In Spain, the access to motorcycles with high performance is based on a model considering the progressivity according to age and experience of the rider. This progression postulates that the performance of a vehicle develops in parallel with the experience of its driver. In 2009, the Progressivity according to age an experience was regulated: A new kind of "intermediate" license between the A1 and A licenses, called A2, was introduced. The new A2 license allows persons being older than 18 year to drive motorcycles up to 400 cc. Hence, to be able to access the A license, it is indispensable to have held the A2 for at least two years.

http://www.svmc.se/upload/SMC%20centralt/Dokument/rapporter/PTW-Road-Safety-Plan-Draft-English.pdf

The Czech Republic has implemented a guideline that allows for a more step riding test. The Act on obtaining and improving the professional ability to drive motor vehicles - Act No. 247/2000 - G7 - Article 42, 43 was implemented in 2000 by the Ministry of Transport. To obtain the license for riding a motorcycle, a test has to be passed that consists of two parts: in a first step, the candidate has to prove basic knowledge about how to prepare the motorcycle before using it, he needs to be capable of starting the vehicle at various levels of difficulty, stopping the motorcycle, reversing and turning at reversing, driving into a limited space and out of it, longitudinal, stopping and starting on an uphill gradient, driving the motorcycle at a low speed, at least up to 30 km/h. In the second part of the test, the applicant on driving license has to prove knowledge concerning safe motorcycle driving

- in various intensity of traffic and on various types of roads,
- at an intersection, which is controlled by traffic lights,
- in rural areas with public transport
- at marked pedestrian crossings
- outside of the built-up areas and in case of big towns, at least, on a multi-lane road with a speed limit of at least 50km/h
- at higher speeds and in various maneuvering situations
- concerning rapid, safe and correct decisions and reactions in specific traffic situations

The implementation of a graduated licensing system in Austria in 1991 has cut young riders' deaths by about 75% and injuries by about 50%.

Beneficiaries:

Mainly young novice riders.

Clear definition of the problem

Riding is especially risky when one lacks in experience as a new rider. In addition, the risk perception and riding attitudes of young riders are contributing factors to riding behaviour and hence road accidents.

Size of the problem

Inexperience and the young of age are important contributing factors to road accidents. Many studies have discovered a particular high accident risk among young novice riders.

Scientific Background

There is a great number of studies of the effect of graduated licensing on drivers, and the result is a reduction in the number of accidents and accident severity. However, there is also a study (Reeder, et al, 1999) on the effect of this measure on PTW traffic crash hospitalizations. The result was a significant reduction of 22% in hospitalizations for the 15-19 age group. However, the reduction in crashes (or part of it) could be attributed to an overall reduction in exposure.

As this measure works for young/novice drivers it is expected also to work for riders. As the rider gets experience in riding he/she is then allowed to ride in more risky situations.

The measure is expected to target the identified problem to a high extent.

Expected impact

As indicated above, significant reduction of accident numbers and injuries can be expected.

Implementation, Acceptance

It has to be considered that there are various interest groups concerned like riders' associations, industry and educational bodies. Changes to the licensing system integrating the interests of all these groups may be difficult, time consuming and they are sometimes subject of various political interests instead of simple transfer of scientific evidence into legal provisions.

Sustainability

Graduated licensing aims at reducing young novice riders' accident risk and achieve effects that last at least for the period a respective system covers. Hence, graduated licensing is a measure of improving sustainability. However, the systems should aim at creating effects that remain for longer than just for the period new riders are directly affected by the system.

It has to be noted that changes in the system of education may also affect exposure. For evaluation it is difficult separating between effects of improved "quality of riders" and other effects that may appear and are also difficult to measure. It has frequently been observed that a sound before-and-after comparison could not be done because the measurement of relevant parameters in the before-phase was not carried out.

Transferability

Graduated licensing has already been successfully implemented in the US, Canada, Australia and New Zealand as well as in Europe for both riders and drivers. These systems strongly differ from each other, however, there are clear recommendations which elements are needed for designing a most effective graduated licensing system. Solutions might have to be tailored towards the particular conditions within a country. Existing system might be a barrier, since stakeholders might be reluctant to legal changes, even if there clear scientific evidence on effects.

Costs and benefits

A traditional benefit-cost analysis is difficult since legal changes do not have costs, they only create positive and negative impacts.

Riders' perspective

★☆☆☆☆

Graduated licencing must offer an added value to trainees and to all road users as a whole, by making sure that all stages of training - initial training and subsequent stepped-up licencing - build on the trainee's previous experience, and work in continuity in providing quality training relevant to real-life situations.

Priorities

In many countries, the system for educating and testing young novice riders was subject to huge efforts in design or redesign. Evaluation is difficult,

Initial Rider Training

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★☆☆	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★☆☆☆
Efficiency	★★★★☆	Sustainability	★★★☆☆

It is important to identify the key factors in basic training that effectively make the novice rider capable of safely operating a motorcycle in normal traffic conditions on public roads:

- Learning and understanding the intentions of laws and regulations aiming to promote and maintain road safety.
- Learning basic traffic strategies, e.g. interaction with other road users, speed choice, lane positioning, visual directional control, active hazard search, perception and anticipation.
- Learning precise and effective machine control skills, based on the laws of physics, enabling the rider to be in control of the motorcycle when accelerating, cornering and braking.

Examples:

In a project co-funded by the EU, the representative organizations of motorcycling have developed a new basic manual. The relationship between newly qualified rider overconfidence, failing to recognize hazards and taking risks, and pre-license training focused on machine control skills, has been recognized for a long time. A new model for initial rider training should address all main problems.

The manual covers:

- Theory:
- Road regulations
- Signs and markings
- Machine dynamics
- Hazard awareness
- Helmets and appropriate clothing
- Social responsibilities
- Impairment
- Attitude and behaviour
- Machine control:
- Machine familiarity
- First movements
- Gears, brakes and direction
- Steering and counter-steering
- Low speed manoeuvring
- Hazard management
- Traffic interface:
- Positioning in traffic
- Distance and speed

- Curves and bends
- Junctions
- Overtaking
- Motorways
- Anticipation
- Riding together
- Journey Planning

In the report that accompanied this work, there is also a commentary of the future potential of "e-coaching" to assist in rider and driver training in the future. The manual is currently only available in English, French and Spanish.

http://www.initialridertraining.eu/

Besides, the MAIDS study (ACEM, 2009) showed that nearly 70% of riders within the database were found to have attempted some form of collision avoidance manoeuvre. This is a high percentage compared to around 33% of car drivers in this and other studies. However, one third of these PTW riders lost control while performing the manoeuvre. These statistics show that proper training in hazard awareness and collision avoidance techniques could help to reduce the frequency of loss of control with a resulting accident. Thus, ACEM promotes the introduction into the practical examination of skills which address hazard awareness and loss of control while executing emergency manoeuvres, too.

ACEM (2008). A Safety Plan for Action, p.7

Beneficiaries:

This overall model is beneficial for new PTW riders as well as for other road traffic participants because it does not only focus on machine control skills but also on motorcyclists' behaviour in road traffic. A Europe-wide implementation could lead to more safety in road traffic.

Clear definition of the problem

It is important to identify the key factors in basic training that effectively make the novice rider capable of safely operating a motorcycle in normal traffic conditions on public roads. Examples include:

- Learning and understanding the intentions of laws and regulations aiming to promote and maintain road safety.
- Learning basic rider traffic strategies, such as rider attitude and behaviour, interaction with other road users, speed choice, lane positioning, visual directional control, active hazard search, perception and anticipation.
- Learning precise and effective machine control skills, based on the laws of physics, enabling the rider to be in control of the motorcycle when accelerating, cornering and braking.

As a result of concern about the quality of basic rider training in the EU, the representative organizations of motorcycling agreed that training does not generally meet riders' needs in Europe. Today's training programs generally concentrate on machine control skills to the detriment of hazard awareness and rider attitude and behaviour. A new model for initial rider training should address all main problems.

Size of the problem

There is a high proportion of PTW accidents that involve novice riders (and this depends on the different countries and different training that the riders have before receiving their license).

Scientific Background

Many studies have been carried out on the impact of training, mainly about driver training. However, no study could control for all impact factors. Within the course of the SUPREME project (Sanders, Visser, 2007), no "Best Practice" could be identified following the strict definition for Best Practice used in SUPREME, where the main reason was that effects were no measured properly.

Implementation, Acceptance, Transferability

There are no barriers to implementation from the expert point of view. It well acknowledge, what basic rider training should include and which issue should be considered. However, experience shows that there are severe political constraints due to a lot of stakeholders in the field with competing goals. It also has to recognised that sound basic training need a lot of complementary measures like building up relevant training infrastructure, properly educating trainers, building up knowledge on the field and, last but not least, building up the administrative infrastructure for authorisation of training institutes and trainers.

Expected Impact(s), Sustainability

Sound basic training shall reduce the unproportionately high risk of (young) novice riders, it should also aim at achieving long-term effects. Quantitative figures cannot be provided.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations support licence schemes that focus on teaching the necessary skills to survive on the road, including traffic interface, machine control and attitude and behaviour. Licencing schemes that focus only on the traffic code, or on mastering the skills needed to pass the test, offer little value and should be avoided.

Priorities

High priority should be given to this measure, but in order to be effective it should be carefully designed according to the problems in each country and it should be compulsory.

Age Limitations for Pillion Passengers

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★★☆☆☆
Total impact	☆☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

PTW pillion passengers have to reach a certain age before being allowed to ride with somebody on a PTW. If they do not fit certain age limitations, they are not allowed to ride on a PTW as a pillion passenger. Possible risks are considered to be falling off the PTW as result of a lack of power.

Example:

The Czech Republic implemented a Guideline in 2000 (Act on the road traffic No. 361/2000 - G2 - Article 7) that invites PTW riders not to take persons for a ride unless they reached the age of 12. The Portuguese Highway Code (national guideline implemented in 2005) allows being a pillion passenger at the age of seven.

http://www.prp.pt/informacao/actualidades/act_00107.asp

Austria has recently updated the Austrian Road Traffic Act and raised the age limit for pillion passengers on motorcycles from 10 to 12 years. The argument was harmonization to other rules, although there were no other rules setting the age limit to 12 years. On mopeds, children may be carried along up to the age of 8 years, but they have to use a specific child seat.

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10011384

Beneficiaries:

Children shall be protected from consequences of PTW accidents by this measure.

Clear definition of the problem

Riding on a motorcycle demands certain physical and cognitive abilities. Children under a certain age might not have the physical strength to react properly in specific situations, for example in braking situations. There is a risk that they fall off the motorcycle. The insufficient cognitive abilities increase the danger of a false reaction, which is dangerous for the rider and the pillion passenger.

Size of the problem

Children as pillion riders can be considered as a rather small group, the group of pillion riders under 15 years is estimated around 15 000. Statistics from Germany show that in the year 2009, 2 children under the age of 15 have been killed as pillion riders (Statistisches Bundesamt, Zweiradunfälle im Straßenverkehr, 2009).

http://www.dvr.de/download/US_Zweiradunfaelle_2009.pdf

Scientific Background

Data from Germany shows that traffic is one out of three locations where children between 5 to 14 most frequently have an accident. In the year 2004 approximately 1.6 bn children have been injured in traffic accidents. As one of the main accident mechanism from children and teenagers the study from Kahl (Kahl, H. 2007) names falling. 60,4% of all accidents from children aged 1 to 18 are falling accidents. This high number indicates that the physical and cognitive abilities of especially younger children are not fully developed.

http://edoc.rki.de/oa/articles/re5D5gfxZr3AY/PDF/27CbOnjqoeIQ.pdf

Implementation

Pillion passengers need to have a certain level of physical and cognitive abilities in order to react properly in specific situations. Having reached a certain age does not guarantee that one possess these abilities. Age limitation for pillion passengers is therefore not considered as an adequate measure to enhance the safety for pillion riders and riders. Following the results from Kahl's study (Kahl 2007) that the awareness of teenagers and children for their exposure should be raised, as the information about the exposure of children for parents does not guarantee that children use adequate protective clothing, a more effective measure to enhance the safety of young pillion passengers would be to ensure the use of protective equipment.

http://edoc.rki.de/oa/articles/re5D5gfxZr3AY/PDF/27CbOnjqoeIQ.pdf

Expected Impact(s)

Impacts can easily be measured by discounting all pillion passenger injuries and fatalities below the age limit, which is planned to be implemented.

Acceptance

Although riders might not be in favour of such a limit, measures aiming at protection of children do normally not receive strong resistance. In places or countries where PTWs serve as an important means of transport with no alternative available which is particularly the case in low income countries, such an age limit is not reasonable.

Sustainability

In principle, the age limit is a very sustainable measure. It has to be considered that alternative modes of transport of not without any risk, but quantification of the alternative transportation risk is a local phenomenon, and hence, general figure cannot be provided.

Transferability

Age limitations for pillion passengers can be established in each country, the acceptance of the concerned riders for this measure might be different in each country.

Costs and benefits

Age limitations for pillion passengers are not considered as an effective and useful measure to enhance the safety of PTW riders.

Riders' perspective

★★★★★

The riders' associations object to this measure, as it is not based on any evidence. While European countries have vastly differing rules on this matter, riders and authorities have not reported any difference in accident statistics or casualties on that basis.

Priorities

Priority should be assessed based on local accident record, status of PTW within the modal split and potential alternatives for transport of children.

Riding Without Pillion Passengers

Expert Assessment			
Overall		★★★★★ (0 of 5)	
Size	★★★★★ (0 of 5)	Transferability	★★★★★ (1 of 5)
Total impact	★★★★★ (0 of 5)	Implementation	★★★★★ (1 of 5)
Safety impact	★★★★★ (2 of 5)	Acceptance	★★★★★ (0 of 5)
Efficiency	★★★★★ (1 of 5)	Sustainability	★★★★★ (0 of 5)

The measure involves not permitting novice riders to ride with pillion passengers unless they have gained some experience.

Example:

In Spain, a legalized ban to ride with a pillion passenger exists for moped riders up to the age of 18. In Great Britain, the educational riding scheme allows no riding with pillion passengers if a L-plate is used.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.135

Beneficiaries:

The measure aims on the one hand for a reduction of the accident risk of the rider himself in relation to a possible passenger and on the other hand for rider learner faults by the vehicle handling in the first phase of riding.

Clear definition of the problem

Novice riders have a very high risk, hence riding with pillion passengers may increase the number of injured people in an accident. In addition, young/novice riders may also be distracted at a higher extent by the presence of a pillion passenger, or might even want to show a riskier attitude to impress their peers.

Size of the problem

Riding is especially risky when one lacks in experience as a new rider. In addition, the risk perception and riding attitudes of young riders are contributing factors to riding behaviour and hence road accidents.

Scientific Background

According to our knowledge there is no scientific background to support the measure's effectiveness, as this measure has been implemented and evaluated together with several other restrictions in graduated license schemes.

This measure will reduce number of injured people as there will be one person on a novice rider's bike (i.e. the rider). In addition, distraction from driving can cause accidents for novice riders who do not have yet automatised several of the riding tasks and decisions, last the novice/young rider will not feel pressure to perform as a risky/aggressive rider.

The measure is expected to target the identified problem to a high extent.

Expected impact

General figures cannot be provided, however an estimate of the impact can easily be determined considering relevant riders' accidents and the number pillion passengers they are taking along.

Implementation

Technically, the implementation will be rather easy, barrier will appear in terms of acceptance.

Acceptance

Single restrictive measures are not much appreciated in general, in particular if they apply to particular groups.

Sustainability

The measure is anticipated to be sustainable; however, modifications might be needed for the definitions of the duration of experience or exposure with time.

Transferability

This measure can be implemented anywhere and hence in any European country. However, it would be better that this measure does not stand alone, but is part of a graduated license scheme.

Whether the results of the measure will differ between countries depends on the different conditions defined and the different mentality of the young population as this is represented through riding behaviour in each country. Enforcement also plays a significant role in countries where people do not follow the highway-code.

Costs and benefits

No scientific data available according to our knowledge.

Riders' perspective

☆☆☆☆☆

The riders' associations strongly object to this measure as riding with a pillion is an integral part of rider training, and should therefore be practiced from the onset in order for the training to build experience. Moreover, there is no evidence that riding without a pillion is safer.

Priorities

The expert survey results in poor rating for this measure, the evidence above supports this assessment.

Requirements to Ride a Moped

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★★☆☆
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★☆☆☆

To decrease the number of accidents involving moped riders, specific requirements for obtaining a moped license are defined.

Example:

In the UK, one has to:

- be at the age of 16 or older
- have a provisional moped license
- complete a Compulsory Basic Training (CBT)

Candidates for a moped license must first pass the theory test for motorcycles and then the moped practical test to obtain a full moped license. The national guideline including requirements to ride a moped (Guideline reference number: Law RTA 1988 (as amended) sect 108) was implemented in 2009 as a part of the Official Highway Code in the UK. It regulates the requirements for obtaining a moped license.

Department for Transport (2007). The Official Highway Code, p.106

The European Union is about to implement new requirements for riding a moped. A driver license of category AM will be required after implementation of the 3rd Driving License Directive in early 2013. The standard age limit is set to 16 but may be lowered to 14 or raised to 18 by the Member States. The Directive requires a mandatory theoretical test and leaves it to the Member States to mandate a practical test and a health check previous to licensing. The Directive does not address the issue of training.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:403:0018:0060:EN:PDF

Austria has implemented a moped license in 1991. Condition to acquire this administrative document was passing a theoretical test. The catalogue of questions contained 230 multiple choice questions dealing with legal issues and safe behaviour, supported by photos and figures. The licenses could be issued by anyone who had passed a respective procedure of authorization, including a check of competence. Mainly school teachers, driving school teachers and safety trainers of motorist clubs were authorized. There was no obligatory training; however, most of the candidates passed at least a one day training course including theoretical and practical training. The measure was extremely effective reducing both fatalities and injuries by about 30%.

In 1997, Austria lowered the age limit for moped riding to 15, installing a set of conditions:

- Individual mobility needs to be confirmed by school or employer
- Parents' agreement
- Regional needs with respect to availability of public transport
- Psychological test
- Ban on alcohol (0.01% BAC)

Peace by peace these conditions were abolished leaving only the parents' agreement. It was tried to mitigate the additional risk by implementing mandatory training – both theoretical and practical – and a sort of practical test. This test consists from giving proof of sufficient control skills to the trainer at the end of the practical training. Success war rather limited. Compared to the time with an age limit of 16, the number of injuries increased by several thousand percent rising severely above the level, which was typical for 16 year old riders before.

Beneficiaries:

The measure is beneficial for all road users as it enables state authorities a better test with respect to the driving and riding skills of license candidates.

Clear definition of the problem

Young moped riders comprise a rather vulnerable road user group, and this justifies the need for the design of a framework containing rules that should be applied in order for one to be liable to ride a moped.

Size of the problem

Young moped riders demonstrate high risk almost everywhere.

Scientific Background

An assessment of such a measure took place in Austria and showed a reduction in both fatalities and injuries by about 30%.

This measure is expected to be successful as in many countries apart from an age limit which is usually low (15-16) youngsters can register and ride moped without having had any other type of training. Using a moped involves higher speeds than a bike, especially if tampering takes place. In addition, mopeds travel in the road network and are also treated by the other drivers as motorized traffic. Hence, a moped that is ridden by someone who has not been "authorized" following specific procedures is rather risky.

The measure is expected to target the identified problem to a high extent.

Expected impact

General figures cannot be provided, since the measure includes a variety of measures, which can be implemented separately or complementary. The example from Austria shows that there is strong impact of various measures like psychological testing, theoretical and practical education, theoretical and practical testing as well as other measures. Many of these do not (only) impact to the safety of the individual, but also have an impact on exposure.

Implementation, Acceptance

There a several groups of stakeholders with various, to a certain extent competing interests. Most of these interests will be affected by application of any restriction to moped riding.

Sustainability

As indicated above, there are various preconditions that can be applied to moped riders. Hence, general figures cannot be provided.

Transferability

In principle, restrictive measures for moped riding can be applied anywhere. From the technical point of view, age limits or technical limits might be rather easy to implement, whereas training and testing requirements will need a lot of investment, competence building and respective administrative procedures.

Costs and benefits

No scientific data available according to our knowledge.

Riders' perspective

★★☆☆☆

The riders' associations support licence and training schemes that focus on teaching the necessary skills to survive on the road, including traffic interface, machine control and attitude and behaviour. Licencing schemes that focus only on the traffic code, or on mastering the skills needed to pass the test, offer little value and should be avoided.

Priority

Experience show that priorities in terms of requirements for riding a moped are not limited to the aspect of safety, mobility is an important issue. There is no sound scientific evidence of the safety impact of different kinds of requirements, since control of other impacts is difficult.

Probationary License

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★☆☆☆
Total impact	★☆☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★☆☆☆

This measure involves novice riders, and it defines that PTW riders have to absolve a probationary time from one to two years. If offences in the traffic regulations are noticed, the riders have to undergo additional theoretical or practical education, and there is also an additional duration of time for the probationary license before obtaining the permanent one.

Example:

In Austria, each novice rider gets a probationary license lasting for two years. In the probationary time, the blood alcohol level must not exceed 0.1 parts per thousand (after the probationary time, the limit is 0.5 parts per thousand). If the rider operated a PTW with a blood alcohol level of more than 0.1 parts per thousand or if he committed any road traffic offence (absconding, speeding, failure to yield to traffic having the right of way, etc.), the government agency would impose him additional theoretical education. Subsequently, the probationary time is prolonged for one year.

http://www.help.gv.at/Content.Node/4/Seite.040102.html

Beneficiaries:

Probation licenses are aimed to careful behaviour of novice PTW riders. This way, there should be a longer-term effect on the traffic behaviour.

Size of the problem

Novice riders comprise a particularly vulnerable user group.

Scientific Background

Probationary licensing is an issue o general prevention. Riders shall be encouraged to careful driving, as they are exposed to set of particular measures in case of violations or accidents.

A study by Bartl et al (2000) compared the accident record in Austria before and after implementation of a probationary licensing model. Novice drivers' accident numbers decreased by 19%, whereas for all other car drivers a reduction of only 9% was observer in the same period. PTW riders are not particularly addressed within this study.

Expected impact

Probationary licenses aim at reducing the novice driver and rider risk. Normally, such systems do not specifically address either riders or drivers.

Implementation

In principle, the implementation is rather easy by changing the wording of a law. However, the probationary licensing depends on measures applied to violators. In some cases - psychological group discussion as an individual preventive measure - requires building of competence. Administrative procedures have to set up in any case.

Acceptance

Acceptance by all relevant groups may be considered relatively high, since (young) novice riders are acknowledged as a high risk group.

Sustainability

The measure is anticipated to be sustainable; however, modifications might be needed for the definitions of the "values" given for the different restrictions.

Transferability

This measure can be implemented anywhere and hence in any European country.

Whether the results of the measure will differ between countries depends on the different conditions defined and the different mentality of the population as this is represented through riding behaviour in each country. Enforcement also plays a significant role in countries where people do not follow the highway-code.

Depending on the kind of complementary preventive measures, respective requirements have to be considered like competence building and administrative provisions.

Costs and benefits

No scientific data available according to our knowledge.

Riders' perspective

★★★☆☆

(no comment)

Priority

Probationary licensing models will hardly be implemented for riders only. A more general approach is needed also considering all other novices and other provisions of the relevant licensing system.

Riding Bans for Novice Motorcyclists

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★☆☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

There are several possibilities to introduce riding bans for novice motorcyclists: They can either be based on external circumstances (e.g. time of day, road type) or on the rider's condition (e.g. blood alcohol level).

Example:

In Ontario, USA, as well as in Victoria, Australia, novice riders must have zero BAC when riding a motorcycle. Besides, due to its GLS, novice PTW riders are just allowed to ride during daylight hours in Ontario. In Great Britain, there is a ban for motorways and learning motorcyclists with L-plate, whereas in Italy, mopeds below 150cc may not be driven on motorways under any circumstances.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, pp.136-138

Beneficiaries:

This measure is beneficial for novice PTW riders as it tries to reduce the number of accidents caused by new riders.

Clear definition of the problem

General figures cannot be provided. Restrictive measures have to be defined based on local, regional or national problems, e.g. night time accidents, accidents on weekend. The will also have to consider goals which are different from safety, in particular mobility needs.

Size of the problem

Novice riders are well acknowledged as a high risk group.

Scientific Background

The DAN-report (Bartl et al, 2000) summarised experience with a couple of restrictive measures. The report concluded that single restrictive measures have to be assessed also considering effects at the end of the period they are applied for. Hence, the authors of this report were not in favour of single restrictive measures.

Expected impact

The lower blood alcohol content (BAC) for novice riders cannot be expected to have a major impact. In Europe, the rate of fatalities attributable to alcohol for motorcyclists is around half of that of car drivers (DfT, UK, 2009).

Acceptance

Considering that the majority of PTW accidents are caused by other drivers (MAIDS, 2005), the measure would be difficult to justify with novice riders. This would be especially difficult should these measures be generally applied to motorcyclists, but not to novice car drivers.

Experience is a determining factor in survivability, with the first two years after obtaining a license being the most critical. Measures that ban riders from riding in certain circumstances (at night, on motorways) only serve to slow down the acquisition of life-saving skills and experience, and delay the possibility for the rider to put to use and develop the skills learned during her training.

By 2013, with the implementation of the Third Driving License Directive in Europe, novice riders will have to undergo the following curriculum: AM license at age 14-16, A1 license at age 16-18, A2 license at age 18-20, and A license at age 20-24. A novice rider with an A license will therefore total four license exams over four to ten years, with mandatory training in each case. After such a lengthy and costly process, it becomes difficult to justify that newly licensed riders cannot be trusted, at the risk of undermining the credibility of the training and testing programme.

Therefore, the soundness of such bans should be thoroughly researched before they are enacted. In particular, cost-effectiveness studies should be conducted, and the efficiency of the measure should be compared to alternative solutions (progressive access, advanced training, etc.).

Sustainability

There may be something like a "general sustainability", i.e. all riders will be affected by a measure after implementation without significant fading of effects. However, in terms of "individual sustainability", negative effects at the end of the individual period of restrictive measure are expected.

Transferability

Restrictive measures can be applied anywhere. Issues beyond safety may create serious implications.

Costs and benefits

No evidence could be found.

Riders' perspective

☆☆☆☆☆

The riders' associations strongly object to this measure as riding in the circumstances mentioned (at night and on all types of road) is an integral part of rider training, and should therefore be practiced from the onset in order for the training to build experience. If lower blood alcohol levels are applied to novice riders, these must be similar to levels applied to novice car drivers to avoid discrimination.

Priorities

Neither expert ratings nor scientific evidence provide any reason to prioritise single restrictive measures to (young) novice riders.

Access to Certain PTW Classes for People with a Driving License

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★★☆
Safety impact	☆☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★☆☆☆

Practically, this is not a measure, it is a fact. It is an issue of categorisation of driving licenses and categories of vehicles covered by these license categories. In earlier times, it was very common that car licenses included also the right to ride PTWs. Sometimes limits on engine power, engine displacement and/or construction speed were and still are applied. Today, there are many of these rules still in place, acquired right had to be maintained through changes of licensing systems and even the 3rd Driver License Directive has some elements of this "measure".

This "measure" ist about, to which extent driver training and driving experience from vehicles different from PTW qualify to ride PTWs.

Examples:

In the Austrian driving license law, it is stated that road users, who already possess a driving license (no matter which one), are allowed to ride a moped and do not need a special moped license or any additional training. Category A1 bikes (125cc, 11kW) may be used after going through a 6 hour training and a respective administrative procedure, but without a theoretical or practical test.

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10012723

The 3rd Driving License Directive follows a similar approach. Any driving license is valid for category AM (Article 6(2)(d). Member States may limit equivalency to the other A-categories.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:403:0018:0060:EN:PDF

In the UK, people in possession of a full car license may ride motorcycles up to 125 cc and 11 kW power output with specific plates on public roads. But those people have to pass a CBT course if they have not already done so.

Department for Transport (2007). The Official Highway Code, p.105

Beneficiaries:

It may be considered that "access to PTW" is the beneficiary, i.e. riders in favour of this kind of mobility, industry and dealers selling respective products, to a certain extent also public administration saving time and effort for licensing.

Clear definition of the problem

Neither a car license nor driving experience on cars might qualify for riding a PTW without additional proper training.

Size of the problem

Research (Vavryn, Winkelbauer, Esberger, 2001) found that 5.4 to 13.3 involvements to injury accidents per year and per 1000 vehicles can be expected if car license holder are given the right to use 125cc PTWs without additional requirements.

Acceptance

Practical experience shows that almost everybody welcomes such additional rights to car drivers, except road safety organisations.

Sustainability

Increased numbers on the accident record will be sustainable, the additional mobility as well.

Transferability

This measure can be applied anywhere.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

(no comment)

Priorities

Expert ratings clearly express the additional risk to riding without proper training.

11.2. Post Licensing Training

According to the European Commission, post licensing continuous training for non-professional drivers deserves to be examined, in particular since, with the European population ageing, the question of maintaining older people's aptitude for driving will become increasingly relevant. Possible actions in this area will have to take into account persons with disabilities and elderly people's right to mobility and the adoption of alternative solutions.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.5

In principal, there are two kinds of post licensing training: obligatory and voluntary training. Voluntary training is a type of measure which is close to or even beyond the borderline of campaigning. Hence, any kind of measure which includes any practical exercises or theoretical instructions, which either focuses on handling skills, risk perception or similar issues – even if there are also strong elements of a campaign – will be displayed within this chapter.

Multiphase Education

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★★★★	Sustainability	★★★☆☆

Multiphase Education (MPE) for novice drivers and riders should contain several training modules after the driving test. Its aim is creating a harmonious continuum in driver training by already implemented models like the driving school education and driving test, and on the other hand new models, such as feedback driving in traffic, road safety training on track, and further education in the psychological aspects of traffic.

Example:

In January 2003, the Austrian multiphase programme started on an obligatory basis. In the multiphase programme, there are three training modules during the year following the driving test:

- first feedback drive in road traffic,
- track-based road safety training in link with a group discussion moderated by a psychologist
- eco-driving training

For motorcycles, there is only the track-training and group discussion. Both hands-on training and discussion have to refer to the particular risks, hence, they are completely different for car drivers and motorcycle riders. The Austrian multiphase driver training system was evaluated in 2007, an overall reduction of accident counts by more than 30% was found. Differing from other educational measures, the effect remains for at least 3 years. Unfortunately, there were little effects found in terms of PTW collisions (Pripfl et al, 2010). Thus, the system is about to improved according to recommendations of an expert group.

http://www.kfv.at/department-transport-mobility/safety-measures-in-austria/multi-phase-driving-license/

Beneficiaries:

Novice motorcyclists can improve their theoretical and technical skills and make a contribution in reducing motorcycle accidents. Their behaviour can be influence by psychological education.

Size of the problem

European crash records clearly show that PTW riders are overrepresented in crash records, particularly young males are concerned.

Scientific Background, Expected Impact(s)

An implementation of this measure took place in Austria both for drivers and riders. A reduction of collisions was identified; however this did not involve PTWs. However, improvement of the educational program might also improve PTW road safety. (http://www.kfv.at/department-transport-mobility/safety-measures-in-austria/multi-phase-driving-license/)

Specific aspects of “errors” and “behaviours” of novice riders leading to road accidents are not addressed within the current educational training. Hence, a module that involves these aspects could be successful.

This measure depending on the design of the additional modules could be successful. However, as noted this is not as easy as it sounds, as the Austrian program did not have an effect on PTW accidents.

Implementation, Transferability

Implementation requires investment to training track and knowledge building in terms of educating a sufficient number of trainers and psychologists. Driving school infrastructure has to be improved as well to accommodate the additional workload.

Acceptance

The Austrian study showed good acceptance by riders also assuming that the measure has an impact on safety.

Sustainability

Risk compensation is anticipated to reduce the measure’s effect at the beginning of the new training. However, when this training is not considered to be new, but the actual one these effects are not anticipated.

Costs and benefits

No data available according to our knowledge.

Riders’ perspective

★★★★☆

The riders' associations support voluntary post-licensing training, and often offer it themselves to their members and to all the rider community. Post-licensing training can be supported and encouraged by the authorities, by launching awareness campaigns and offering incentives (in the form of VAT cuts on training, incentives, tax breaks for training schools, cuts on road taxes, etc.).

Priorities

Although the example in Austria did not find any improvement in PTW road safety, priority should be given to this measure, especially in countries where PTW training is rather basic.

Rider Trainings provided by the Police

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★☆☆☆

Initiatives run by police forces working together with the motorcycling community and/or government departments provide technical trainings for private motorcyclists.

Examples:

In the UK, BikeSafe is an initiative run by police forces working together with the motorcycling community. They offer assessment rides and rider skills workshops, including theory sessions. Recommendations to take further training are often the outcome of the assessment rides. Many motor insurance companies acknowledge the value of the scheme and offer a discount on premiums to riders who have completed the programme.

http://www.bikesafe.co.uk/

Also the “Handle It or Lose It” campaign offers targeted training in the form of weekend rider development courses supported by off-duty police riders and other advanced instructors.

http://www.roadsafetyawards.com/national/view.aspx?winnerid=80

In Austria, the Styrian road safety fund finances technical training for private motorcyclists held by off-duty police riders. The courses address riding experienced motorcyclists, train safe riding by controlling the motorcycle in every situation and identify riding mistakes. Also useful tips given by professional motorcycle riders and the demonstration of extreme-situations are included.

http://www.landespressedienst.steiermark.at/cms/beitrag/10550614/374565/

Police training is also provide in many other region in Austria following various approaches, sometimes focusing on on-road training, in other cases on track-based training.

Beneficiaries:

Motorcyclists can improve their theoretical and technical skills and make a contribution in reducing motorcycle accidents. The positive collaboration between the police and motorcyclists accounts for a better and easier relationship.

Figure 67: Technical training[62]

Clear definition of the problem

The problem is that there are possible gaps in rider training, or possible actions that riders do not handle as well as they did initially. Such training may compensate for a lack of practice of riders. Training by police may also improve the general relation between riders and enforcement bodies in order to improve mutual acceptance and improve riders' compliance to traffic rules.

Size of the problem

No evidence of the size of the problem exists, no study could be found that particularly addresses a lack of experience or expertise and skills fading over time with respect to riders and accident records.

Implementation

Depending on the scheme that is applied, there might be a training track needed. Practical examples show that many of the policemen providing training are volunteers, which have to be recruited in case. Complementary training to policemen is useful including psychological and pedagogical aspects, risk awareness and hazard perception.

[62] Source: Verein zur Förderung der Verkehrssicherheit, Police Vienna.

Expected Impact(s)

Additional theoretical and practical training is aimed at improving drivers' knowledge and skills. Police riders are normally considered particularly experienced riders being well aware of the road safety problem and the individuals' behaviour and attitudes.

Acceptance

As for Austria, courses are normally fully booked after announcement, which may be due to the fact that the training normally is provided for free. Political support may be quite popular among riders.

Sustainability

As for any other training, there risk compensation may occur, if the training does not address the issue. Training only aiming at improving riding skills will be much more likely to create such effects than training that also addresses risk awareness and hazard perception.

Transferability

Implementation can be done anywhere. Respective training tracks have to be provided if necessary for the respective training scheme (i.e. not for on-road training). Knowledge building among police riders will be required in terms of pedagogical, didactic and psychological skills.

Costs and benefits

No data available according to our knowledge. Due to the fact that this kind of training is often provided for free and trainers are volunteers, this may be very efficient.

Riders' perspective

★★★★☆

The riders' associations support voluntary post-licensing training, and police forces can often provide motivated and skilled trainers.

Priorities

Expert ratings are carefully positive, possibly considering the risk of creating overconfidence, if risk awareness and hazard perception are not properly addressed in the training lectures.

Workshops for Young Moped Riders

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★☆

Although young riders fulfil the physical requirements for riding a moped in traffic, immaturity, showy behaviour and the adolescent identification process on the road present fatal risk factors. Especially adolescents tend to misjudge critical situations. Their attitude can be positively influenced by rider training, first-aid skills and theoretical know-how.

KFV and its partners offered experimental workshops for 15-16 year old active and potential moped riders. Beside technical rider training the adolescents were instructed how to avoid critical situations and how to prevent accidents. Also first-aid education and information about the legal situation concerning tuning were offered. An evaluation of these workshops showed that the adolescents could be influenced positively.

http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/steiermark/aktionen/erlebnisworkshop-sicher-auf-zwei-raedern/

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing road accidents.

Figure 68: Workshop for young riders[63]

Clear definition of the problem

Young/novice riders illustrate immature behaviour due to their age and also inexperienced behaviour due to their lack of experience. This increases the probability of them being involved in an accident.

Size of the problem

Young/novice moped riders comprise a rather vulnerable road user group.

Scientific Background, Expected impact

To our knowledge there is no scientific background to support the measure's effectiveness.

This measure will likely be effective; however, it is only one piece a puzzle targeting the high risk of young moped riders.

No side effects are anticipated, as this is not a specialized course – risk compensation is mainly anticipated when a workshop is specialized in particular abilities.

Implementation

There are no barriers to this measure. If this is voluntary, however, incentives should be given to young moped riders to participate.

Critical issues mainly involve the context of the workshop, so that it manages to address the "issues" that make young moped riders more prone to being involved in road accidents. Another critical issue is whether the participants should pay for the course – as this addresses rather young people (adolescents) who would prefer to spend their money on other stuff.

Participants should not feel patronized during the workshop.

Awareness can be raised through schools, training schools, or the administrative body where riders obtain the moped "license" and the media.

Acceptance

The measure offers advantages to all groups involved, either by gaining additional knowledge and skills (riders), publicity (organisers) or simply a lower number of accidents and hence, a positive macroeconomic impact.

Sustainability

The measure is anticipated to be sustainable; however, modifications on its content might be needed with time, so that it addresses the actual needs of each era.

[63] Source: http://www.kfv.at/size2/kfv/landesstellen/steiermark/aktionen/erlebnisworkshop-sicher-auf-zwei-raedern/, 2012 02 29

Transferability

This measure can be implemented anywhere and hence in any European country or elsewhere.

Whether the results of the measure will differ between countries depends on the contents of the workshop and the different mentality of the population as this is represented through riding behaviour in each country.

Costs and benefits

No scientific data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations support this measure because training is the best way to increase the safety of young PTW users.

Priority

The measure receives strong appreciation from experts. By Austrian experience, it is also welcome by young riders and all other stakeholders.

Practical Training for Novice PTW Riders

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★★★☆☆

Practical training for young PTW riders improves their skills and attention in road traffic and contributes this way to the reduction of PTW accidents. This measure addresses voluntary post-licensing training.

Example:

AIB recommends that motorcyclists must be encouraged to attend driving courses, e.g. when they acquire a new motorcycle, or when a motorcyclist resumes riding after a pause of several years. It is important to practice braking, avoidance and curving techniques. It is important that courses focus on motorcyclists' driving abilities being used to increase the safety margin and not higher speeds.

AIB (2009). Motorcycle Accidents, p.75

In Germany, one-day safety trainings according to DVR certificates are held by several organizations. These are basic courses for male and female motorcycle riders, whereas novice and re-entry riders benefit from this kind of training just as much as experienced riders. The aim of the eight hours of safety training is to become aware of possible risks, and to avoid or to manage them. Practical exercises of the program include: Physical balance in difficult situations, stopping/braking on different road paving, swerving without hitting the obstacle, cornering on a circular track. Apart from practical riding, the participants exchange experiences and discuss further important aspects like anticipation of dangerous situations or the influence of external conditions on ones riding skills. In addition, there are practical tips on vehicle technology, protective gear and helmets. Next to this basic course, ifz also developed specific concepts of rider training for various motorcycle categories (e.g. trainings on race-tracks, trail courses, enduro trainings and sidecar trainings).

http://www.ifz.de/e-training-conceptcontents.htm

Collaboration between KfV and a driving training centre resulted in a practical riding training for young moped riders. It includes the topics: slalom riding, the blind spot of a car driver, the estimation of the reaction channel in practical exercises, braking exercises, safety distance and the right visual behaviour for stabilized riding in bends.

http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/salzburg/aktionen/sicher-unterwegs-mopedpraxis/

According to the PROMISING project, the curriculum of novice rider training should include the following objectives to influence the traffic behaviour:

- increasing danger recognition
- improving risk recognition
- lowering behaviour to take risk

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.133

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing road accidents.

Figure 69: Practical training on a moped[64]

Clear definition of the problem

Novice riders risk is rather high compared to experienced riders. Practical training will make riders more capable of dealing with more complex situations or with situations that require a certain degree of mastery skills.

Size of the problem

Generally, novice riders risk is rather high (2BESAFE WP1 has results on this for each country); hence this measure could reduce the number of accidents where novice riders are involved.

Scientific Background

There is no scientific evidence of the impact of the measure; however it is expected to reduce PTW accidents with novice riders. Practical training is essential for riders and drivers as they could cope in a more appropriate way under real traffic conditions.

Implementation

The additional cost for designing such training comprises an implementation barrier.

The practical training should be compulsory and the specific conditions that riders encounter when riding in traffic should be included somehow in the training.

Awareness can be raised through educational bodies, campaigns and the media.

Expected Impact(s)

This measure is expected to improve PTW road safety, in accident where novice riders are involved. Due to particular vulnerability of the group, it is easy to suppose positive impacts, however, no scientific evidence could be found.

[64] Source: http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/salzburg/aktionen/sicher-unterwegs-mopedpraxis/, 13 Aug. 2009

Acceptance

In general, offering voluntary training on the market will hardly face any resistance. Acceptance in terms of numbers of riders' participation in such training on a voluntary basis will strongly depend on the price. Even if training is offered for free, such training will only be done by a small minority.

Sustainability

Risk compensation is always an issue in additional education modules. Additional knowledge and skills acquired by individuals may also fade over time.

Transferability

This measure could apply anywhere; however in several countries PTWs receive practical training. This however could also be improved. The practical training should not be the same in every area. For example in countries where PTWs are mainly used to avoid congestion filtering and lane splitting situation should be well dealt with. In countries where PTW riders ride mainly for fun, riding in bends should be more important.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations support this measure because training is the best way to increase the safety of young PTW users.

Priorities

Experts appreciate safety impact and compliance to a severe safety problem. Lack of transferability and sustainability of effects downgrade the overall rating.

Deceleration Tester

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★★☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	☆☆☆☆☆

The proper use of brakes is one of the most important skills of PTW riders. With a measuring system based on light barriers, emergency braking and stopping distance of one's own PTW can be tested. The riders can thereby get to know their motorcycle better and they learn how to break in critical situations.

Example:

KfV offered a braking test for prospective moped riders with the objective of improving the awareness for right behaviour and braking. The measuring system displays the deceleration immediately and the riders learn how to reach a high deceleration at low risk.

The activity is embedded in a safe driving training. The instructor gives comprehensive information on correct brake handling of PTW highlighting the effects of assistance systems. The equipment measures speed twice, calculates mean deceleration from time elapsed and displays it to the trainees.

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing road accidents.

Figure 70: Test set-up[65]

Clear definition of the problem

Emergency braking with PTW is difficult task from mainly two reasons: Although human is a single-channel controller, PTW riders have, in most cases, to operate two independent braking devices. When wheels lock up during braking, it normally take less than half a second until the rider and the vehicle falls and hits the road surface, if no countermeasures are taken. PTW riders are well aware of this issue. Proper training has to address two issues: On the one hand, it is necessary to teach correct brake handling, on the other it would be necessary to overcome the "survival reflex", i.e. in case of emergency, PTW riders tend to brake as hard as they can, cause the wheels to lock and hence, fall off the vehicle.

However, proper training is difficult, since approaching the limit already implies a certain risk.

Size of the problem, Scientific Background

See chapter on ABS and other Advanced Braking Systems. The 3rd Driver License Directive Requires a deceleration test as an element of the practical driving test, quantitative criteria for passing the test is not provided.

Expected impact

Vavryn & Winkelbauer (1998) found the average deceleration of a PTW rider at about 6 m/s², using the braking potential of the front brakes by only 42% on an average, the rear brake by 169% (which is possible by poor front brake application with respect to dynamic shift of wheel forces). Skills should be improved during basic driver training and retraining, deceleration of 8m/s² seems achievable.

Using this equipment for training allows for slowly and carefully approaching the limit and, hence, reduces the risk during training. The equipment could also be used for testing.

Implementation

The equipment displayed above was a prototype at a price of 14,000€. If these devices are built in larger numbers, the price would decrease to less than 2,000 €. The equipment is easy to move and easy to use. Additional knowledge should not be necessary assuming the a properly educated driving instructor has all knowledge required.

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[65] Source: Winkelbauer (2007) Der KfV Bremstest, p.1

Acceptance

Riders enthusiastically participated in the training. If implemented as a requirement for testing, this would likely create resistance from organisations which have to cover expenses for purchase of equipment.

Sustainability

The method per se has no risk of fading if durable equipment is consequently used. The drivers' additional skill may fade over time and will need periodic retraining.

Transferability

Respective equipment should be easily available worldwide, properly educated trainers are required.

Costs and benefits

The measure was not evaluated in terms of crash statistics.

Riders' perspective

★★★☆☆

The riders' associations support this measure because it contributes to increased riding experience, especially for novice riders.

Priorities

The measure achieves a top rating in terms of safety impact, other ratings are optimistic.

Ride-Outs for New PTW Buyers

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★★★☆
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★☆☆☆

Collaboration between PTW dealers and Road Safety Institutions is an approach to get in touch with motorcyclists. On the one hand, a ride-out with an expert is one kind of technical training and on the other hand, the buyer has the possibility to get to know his/her future vehicle better.

Example:

Warwickshire Police’s "Scootersafe" campaign teams up with scooter dealers to offer new scooter buyers a free one-to-one ride-out with a member of the force’s "BikeSafe" team.

http://www.scootersafe.org/

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing road accidents.

Clear definition of the problem

This initiative addresses two issues: Experienced riders are invited to receive feedback from an experience trainer relevant for the new vehicle they are using. Riders who are new to the activity receive training complementary to the training they have received during driver education before.

The activity encourages post-licensing training and may be particularly relevant to returning riders after a longer period of absence to the activity. There are no official obligations of training to such riders; voluntary training is likely to improve their skills at the beginning of a "second rider career".

Size of the problem

During the recent years, the accident records about PTW riders have undergone a radical change. Previously, it was predominantly young riders being involved in PTW crashes. In a majority of EU countries, there are no predominant age groups in the PTW crash statistics any more. Voluntary retraining of experienced and returning riders may, hence, be considered

Scientific Background

No information could be found on actual safety impact of such measures nor can other information on effectiveness of training in real traffic be used due to the particular purpose of training riders who have recently bought a new vehicle.

Implementation, Acceptance

If training is particularly provided to vehicle purchasers, it may be assumed that this is driven by dealers and is a sort of incentive from the dealer offered to the purchaser at an attractive price. The price might be most important determinant in terms of acceptance. Qualified trainers have to de recruited and, in case, be trained with respect to the type of purchasers and vehicles they are offering training for.

Sustainability

Sustainability is a twofold issue: On the one hand, this may be considered sustainable if permanently offered by dealers instead of being a short term marketing instrument. On the other hand, training effects have a tendency of fading, if there is no periodic retraining.

Transferability

This may be implemented anywhere.

Costs and benefits

No information was found.

Riders' perspective

★★★☆☆

The riders' associations support this measure because it contributes to increased riding experience, especially for novice riders with mopeds and 125cc scooters and motorcycles.

Priorities

This measure addresses a rather small, but very particular group of PTW riders. Training is offered in a very critical phase of a rider's career. Maybe considering the limited number of riders addressed, this measure receives moderate rating by experts.

Group Work and Problem Based Learning in Experienced Rider Training

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	☆☆☆☆☆
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★☆☆

The main ideas for group works are to give participants a realistic picture of risks in motorcycling and also give ways to reduce the risks that riders take. The instructor does not only have a practical role, but also provides data of fatal motorcycle accidents. The peer group of motorcyclists can talk about this data and analyse it independently. The group work could be the theoretical part of a one or two days riding course, including also field training, basic manoeuvres for dangerous situations.

Example:

This type of group work is used in voluntary experienced rider training organized by a motorcycle club MP69 in Finland. In the first part of the group work, the participants are analyzing fatal motorcycle accidents, trying to find accidents in which they could be involved. Also the riders own “near-by accidents” and other experiences are used as material as well as the own riding in general as a reference. At later stages, survival means are developed and discussed. All ideas and experiences are used to draw a conclusion for one’s own riding behaviour. During the group work, the participants usually are analyzing, dealing and developing their perception strategies, “see the danger”, they are motivated for field training and, hopefully, getting an attitude for more conscious risk taking.

http://www.msf-usa.org/imsc/proceedings/c-Kortesuo-GroupWorkinRiderTraining.pdf

Beneficiaries:

Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

Clear definition of the problem

The main problem involves PTWs demonstrating risky behaviours without considering the risks but thinking “an accident will not happen to me” or “I am capable rider and can prevent a potential accident”.

Size of the problem

Careless and risky riding behaviour are contributing factors to PTW accidents.

Scientific Background

According to our knowledge there is no scientific background to support the measure’s effectiveness.

This measure could work, but our impression is that it might only affect the behaviour of a small rider proportion, especially since it will be on a voluntary basis.

The measure is expected to target the identified problem to a low extent.

Expected impact

The measure is likely an impact on road safety. The measure might improve PTW riding behaviour and hence reduce PTW road accidents and accident severity.

Implementation

There are no barriers other than budget issues and the need of effective organizing such workshops.

A critical issue is whether the workshop will be at a voluntary basis – which means that people attending it will be already conscious of the risks of riding a PTW and do not need to be shown additional data to realise it. However, if it is still on a voluntary basis, incentives could be given to highway-code offenders from the police/any relevant administrative body or from insurance companies.

Avoiding showing too many details during accidents that could “harm” someone psychologically should be avoided.

Awareness of the measure can be raised through media, training schools, campaigns and police or insurance companies.

Acceptance

All relevant groups will accept the measure. The group that would need such training the most is possibly not coherent with the rider groups that would benefit the most.

Sustainability

From all kinds of (voluntary) post-licensing training, this kind of training is likely to create the most sustainable effects.

Transferability

This measure can be implemented anywhere and hence in any European country.

Whether the results of the measure will differ between countries depends on the contents of the workshop and the different mentality of the population as this is represented through riding behaviour in each country.

Such kind of training requires highly educated trainers.

Costs and benefits

No scientific data available according to our knowledge.

Riders' perspective

★★★★☆

The riders' associations support voluntary post-licensing training, and often offer it themselves to their members and to all the rider community. Post-licensing training can be supported and encouraged by the authorities, by launching awareness campaigns and offering incentives (in the form of VAT cuts on training, incentives, tax breaks for training schools, cuts on road taxes, etc.).

Priority

Although there is hardly any statistical evidence for overall impact of this measure, the approach seems to be very promising, since it considers psychological methods, which have been approved repeatedly. Experts provide a high rating.

Training of Practical Behaviour on a PTW-Simulator

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★★☆☆	Implementation	★★★☆☆
Safety impact	★★★☆☆	Acceptance	★★★★☆
Efficiency	★★☆☆☆	Sustainability	★☆☆☆☆

A computerized traffic simulator allows (beginning) riders the opportunity to operate a motorcycle in real-life situations without the inherent real-world risks and consequences. The trainer's software simulates different scenarios and hazard prediction courses are testing the rider's accident avoidance and prediction skills. The scenarios can be run in different condition modes (day, night, fog) as well as in city riding, touring, manual transmission or automatic modes. After completing any riding scenario, a trainer-generated feedback is provided and can be printed in the form of a Completion Certificate, which scores the rider at each hazard of the selected course.

Example:

KfV collaborated with a driving training centre and they offered a safety activity for 15 to 16-year old students. During group sessions, the risk behaviour of the adolescents was discussed. Afterwards, the students had the possibility to test their practical behaviour on a PTW-Simulator.

http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/salzburg/aktionen/sicherheitsaktion-sicher-unterwegs-mit-mopedsimulator/

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing road accidents.

Figure 71: PTW simulator[66]

Clear definition of the problem

On-field testing and training are of great importance in PTW safety research, but testing in real-life scenarios implies to undertake major risks for the riders. In other words, it is not possible to evaluate riders behaviour during critical manoeuvres such as undertaking or obstacle avoidance without exposing subjects to a high risk of accidents.

Size of the problem

Behavioural and ergonomic research is a prior need in order to reduce injuries and fatalities on the roads. This kind of research implies the use of field testing, that is, based on what stated above, directly connected with the use of simulator devices in research, that first have to be fine-tuned and then to be employed in order to effectively replace real motorbikes in real road conditions while testing.

Scientific Background

Scientific evidence is yet to be achieved. In the scope of 2BESAFE project itself, a set of activities have been specifically devoted to gain scientific acknowledgement of the effective role, scope and impact of this measure (particularly, in WP4.3 and WP5.4)

Based on the outcomes of the above-mentioned activities, simulators are turning out to be reliable tools to perform specific manoeuvres such as obstacle avoidance or overtaking, as the vehicle dynamics is reproduced with a satisfactory level of fidelity, and rider behaviour turns out to be compared to similar manoeuvres in real road conditions. This means that riders could be trained on how to behave in critical situations (e.g. an unexpected obstacle on the road) without undertaking any risk for their safety.

Rider simulators are yet to be completely validated, as further research is needed. Nevertheless, for specific situations as the above-mentioned one, it turns out to be a direct way to approach the problem. In other words, if now riders can learn how to avoid obstacles only by experiencing critical situations on the road, with simulators they could experience it safely and therefore be more prepared in case the event occurs.

Implementation

First of all, further research is still needed, before a wide-spread implementation of simulators could be taken into account. Then, simulators are costly and need time for implementation and fine tuning. Riding trainers require additional training in proper use of simulators for rider training.

For sure the research that will fine tune simulators must be well focused in order to standardize results and assure reliability in their performance.

[66] Source: http://powersports.honda.com/Assets/Galleries/Experience/HondaSMARTRidingTrainer_03.jpg, 12 Aug. 2009

Simulators so far have demonstrated to be not reliable in speed perception: unless further research will solve this problem, simulators cannot be used to train riders on this particular aspect

In case simulators are adopted widely, they are great dissemination tools themselves, for the technological – if not playful – aspect that they imply.

Expected Impact(s)

Simulators are an effective tool of training hazardous situations. Current simulators lack in providing a realistic feeling of riding, hence, application is limited to training of hazard perception and risk awareness. However, such training is generally considered to be very useful, in particular for you riders.

Acceptance

According to practical experience, even simple riding simulators are well accepted by the target group. However, simulators are still not extensively used in order to partly replace or complement practical on-road training. Experienced riders have some concerns since hardly any simulator provides a reasonable feeling and evasive manoeuvres cannot be trained.

Acceptance would also be needed by providers of driver training (driving schools) and public administration, if mandatory training should - to a certain extent - be replaced by simulator training.

Simulator sickness is an issue, which is relevant for a considerable share of the population.

Sustainability

The major risk could stay in an overconfidence given by the use of simulator: riders think they are now able to face any kind of risk when they are on the motorbike and therefore they underestimate real road risks. Practically, the simulator is the only means of practical training which allows for using "trial and error" approach for rider training.

Transferability

Simulators can easily be applied anywhere. Costs are a major issue.

Costs and benefits

No data could be found.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

Simulators, to a certain extent, fill a gap in rider training. Training on particular risky situations, hazard perception and risk awareness cannot easily be implemented in theoretical and practical rider training. Simulators are the only means of using "error" as a tutoring principle. On the other hand, simulators currently affordable for training purposes do not provide a realistic feeling of riding, which limits the learning effect. Considering all this, the measure receives a moderate rating from experts.

Establishment of an Advanced Riding Network

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★★☆	Sustainability	★★★☆☆

The formation of a network of voluntary, local riding groups, which provide structured, voluntary training with respect to practical and safety information as well as the organization of social events, could have a noticeable impact on reducing motorcycle accidents and fatalities.

Example:

Hugh Curran and Jon Taylor published the idea of FAME (Fondation Avancé des Motards Européens), a non-profit, EU-wide Advanced Riding Foundation with an extensive network of local FAME- groups across the EU-27. Once established, this self-help long-term initiative would be managed and supported by motorcyclists themselves. This concept is not completely new, it bases on proven Advanced Riding models in the UK (RoSPA, IAM). Each local group provides structured voluntary training (classroom theory and on-the-road training), social events (ride-outs, trips, First Aid training, contact with the Police, etc.) and the possibility to obtain a certificate by passing a test to ensure that the members are constantly reinforcing their skills.

Beneficiaries:

Riders willing to participate in the program.

Clear definition of the problem, Size of the problem, Expected impact

A tutoring system aims at improving rider skill with a particular focus on advanced hazard perception skills and risk awareness. It may be assumed that a lack of these skills and knowledge is a contributing factor to the relatively high risk of PTW riders, where quantitative figures are not available to support this generally accepted assumption.

Implementation, Transferability

A system as proposed by FAME is not easy to be set up from scratch. Tutoring systems are quite common in the English-speaking world and have grown for a long time.

However, transnational transfer of knowledge based on a European initiative could possibly provide the initial spark to launch such systems in many countries.

Acceptance

Acceptance of such a system is limited to certain groups of riders, willingness to learn - and later willingness to provide knowledge - are a necessary condition for those taking part.

Sustainability

Once set up, such a system is self-supporting and hence, highly sustainable, even for the individual since it implements a system of periodic retaining and gradual improvement of skills. However, there is a certain risk that additional handling skills, if not complemented by skills in hazard perception and risk awareness. I f a system manages to create a good group of trainers, this problem will unlikely occur.

Costs and benefits

So far, no evidence could be found. However, considering the fact that the system is self-supporting and trainers provide training on a voluntary basis, such a system would be highly efficient.

Riders' perspective

★★★★★

The riders' associations support voluntary post-licencing training, and often offer it themselves to their members and to all the rider community. Post-licencing training can be supported and encouraged by the authorities, by launching awareness campaigns and offering incentives (in the form of VAT cuts on training, incentives, tax breaks for training schools, cuts on road taxes, etc.).

Priorities

There are a lot of good arguments to support such a training scheme, experts seem to be not convinced about the impact and have strong concerns in terms of transferability.

11.3. Behaviour

Code of Behaviour for PTW Riders

Expert Assessment			
Overall		★☆☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

For safety reasons, certain kinds of behaviour are not permitted on the public road network. To ensure that PTW riders strive toward safer behaviour and interaction with other road users, guidelines are issued with the aim of improving user behaviour. In addition to the traffic code, these guidelines may cover specific aspects of PTW riding and use, such as excessive noise at certain times in residential areas, parking in cities and on sidewalks, or activities that interfere with the riding task (e.g. smoking, cell phone using).

Example:

The Czech Republic implemented a Guideline in 2000 (Act on the road traffic No. 361/2000 - G2 - Article 7) that invites PTW riders to behave in certain ways.

In Sweden, motorcyclist association SMC (Sveriges MotorCyklister) has taken action towards Vision Zero for the future, with an attitude survey of motorcyclists (results expected end of 2011), and a joint strategy with the Swedish Transport Administration for the period 2010-2020 (Swedish Transport Administration, 2010) aiming at reducing PTW fatalities by half and serious injuries by 25%.

In Belgium, the new traffic code enforced since September 2011 allows motorcyclists to filter through lanes of traffic under certain conditions (maximum speed 50 km/h, no faster than 20km/h above traffic speed), and to park powered two-wheelers on sidewalks (provided there is no obstruction and a space of 1m is left open for pedestrians).

Beneficiaries:

Rules of behaviour for PTW riders are beneficial for mutual acceptance and respect of all road users. Furthermore, complying with the rules improves the road safety of motorcyclists.

Clear definition of the problem

Codes of behaviour, especially if designed with the help and input from users' associations, can provide an adequate answer to issues that originate from a minority of users or that cannot be solved with changes in the traffic code.

Size of the problem

The size of the problem depends on the nature of the problem addressed. This measure is typically beneficial in cases where the problem addressed is not directly related to road safety (e.g. parking, noise), reaches across several fields and involves several partners (e.g. Vision Zero), or aims at improvement in some areas of user behaviour (e.g. benefits of protective equipment, proper maintenance, risk awareness or training).

Scientific Background

The justification for using this measure in addressing a problem depends on the nature of the problem addressed.

Expected impact

The impact of using this measure in addressing a problem depends on the nature of the problem addressed. The measure can be a more flexible, more efficient substitute to changes in the traffic code for specific areas for action, especially if involving several partners, such as users' associations, local and regional government, road operators, the media or the industry. Codes of behaviour that educate riders about risks and hazards, including specific characteristics of the local climate and infrastructure that could affect riding, can be deployed in support of wider safety initiatives.

Implementation

Implementation should take into account the results of sound research in PTW safety as well as the inputs of the motorcycling community, in order to ensure that the guidelines fit the needs of motorcyclists in safety as well as other fields, and that the measures are understood and accepted by the majority. In particular, safety rules that do not have a sound base should be avoided, and so should rules that are not relevant to real-life situations.

Acceptance

Acceptance depends on the issue being addressed by this measure.

Sustainability

Sustainability is high as long as the codes are kept up to date with the reality of PTW riding, and are disseminated to riders.

Transferability

Transferability is low, because of varying conditions, road infrastructure, climate, PTW fleet, PTW use, and driver and rider demographics from country to country and from region to region within a country.

Costs and benefits

This kind of measure is variable, as indicated above. Costs and benefits have to be determined based on the problem which is addressed in each particular case.

Riders' perspective

★☆☆☆☆

(no comment)

Priorities

As the Swedish example shows, such a measure can be implemented very successfully. The most important condition is a positive attitude towards cooperation among all relevant stakeholders. However, the Swedish example even show that bad conditions can be turned into the opposite, if a small group of representatives take the lead and lobby such an initiative among the groups they are representing.

This measure may be considered as the best example of implementing sustainable cooperation. Nevertheless, the expert rating is rather low.

Legal Conditions for PTW Pillion Passengers

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★★☆
Safety impact	★☆☆☆☆	Acceptance	★★★☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

Certain rules of behaviour for pillion passenger aim at increasing the safety of PTW riding. Such rules can include proper helmet wearing, minimum age requirements for pillion passengers, or bans on riding side-saddle.

Example:

The Czech Republic implemented a Guideline in 2000 (Act on the road traffic No. 361/2000 – G3 - Article 9) that invites PTW pillion passengers to behave in certain ways.

In Belgium, the new traffic code enforced since September 2011 bans pillion passengers from riding side-saddle.

Beneficiaries:

This measure addresses the safety of pillion passengers and of the riders they are sitting behind.

Clear definition of the problem

Legal requirements may be implemented to improve safety of pillion passengers and the riders they are sitting behind. The basic idea is to protect riders before their passengers and the other way round.

Size of the problem

The problem is near-inexistent: accident data available in Europe shows that there is no difference in accident risk between motorcyclists riding alone and motorcyclists with a pillion. Across European countries, there is no difference in accident risk between countries that enforce age regulations for pillion passengers and those that do not. According to the conflict study performed with 2BESAFE in nine European countries, motorcyclists carrying a pillion passenger make less riding errors, and do not in any way ride less safely than average.

Scientific Background

There is no data supporting the implementation of measures directed at pillion passengers beyond the existing traffic law, which already covers the basic obligations that apply to all motorcycle users, passenger and rider alike.

Expected impact

In general, the share of passengers on PTW is rather low. It may be considered that most of the riders tutor pillion passengers before they take them along. Safety-relevant skills and behaviours required from passengers should be included in the basic driver training. Hence, significant impact on safety cannot be expected.

Implementation

If implemented, the measure should be supported by the results of sound research in PTW safety as well as the inputs of the motorcycling community.

Acceptance

This is a measure including various issues. General figures cannot be provided.

Sustainability

Sustainability is high as long as the rules being enforced answer a real safety need, and take into account the results of sound research in PTW safety as well as the inputs of the motorcycling community. In case of voluntary measures, sustainability will strongly depend on how such a code of behaviour is disseminated. Without continuous dissemination, there's no continuous effect.

Transferability

Transferability is low, because of varying conditions, road infrastructure, climate, PTW fleet, PTW use, and driver and rider demographics from country to country and from region to region within a country.

Costs and benefits

Costs of legal provisions are normally considered to be zero; hence, a formal benefit-cost calculation cannot be executed.

Riders' perspective

★★★★★

(no comment)

Priorities

There may be a certain level of acceptance for a number of legal provisions for passengers, e.g. a limit for age or size of a passenger. I might be more efficient in terms of pillion passenger safety to promote safe behaviours as recommendations to riders to inform their passengers on safe behaviour before starting a ride.

12. Traffic Law and Enforcement

Framework for Motorcycle Law: Road Traffic Law

Expert Assessment			
Overall		★★★☆☆	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★★☆	Implementation	★★★☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★★☆☆	Sustainability	★★☆☆☆

Road traffic law sets up rules addressing road infrastructure, vehicles and road users. Some of these rules are harmonised at international or European level, others are national rules. In terms of behaviour, rules may address drivers and riders, other road users, vehicle owners and of course, those who are responsible for enforcement of traffic rules.

Today, the existing system of traffic rules might not be considered a "measure", but in fact it is compared to a state of ultimate anarchy, i.e. a traffic system without any rules to any stakeholder. Nevertheless, it is mainly changes to the traffic rules which the term "measures" is used for.

Examples:

In Austria, the Austrian Road Traffic Act defines the "Rules of the game" on Austrian roads. Originally, this national guideline was published in 1960 by the Republic of Austria, but it has already been revised several times. Today, it is structured in 13 sections and consists of 106 paragraphs. Although they are valid for all road users, they define rules for particular road users (e.g. motorcyclists) in some cases.

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10011336

The Australian Road Rules form the basis of Road Rules of each Australian state and territory. Although they are model rules only and have no legal effect, they are identical in most respects to the Road Rules of each Australian state and territory.

The latest version of the Australian Road Rules was reviewed (i.e. February 2009). It is a 400 page document with a collection of 354 rules. The rules generally apply to motorcyclists the same way as they apply to drivers but 16 of them are specific for motorcyclists:

- 55 How to give a stop signal by giving a hand signal
- 98 One-way signs
- 99 Keep left and keep right signs
- 111 Entering a roundabout from a multi-lane road or a road with 2 or more lines of traffic travelling in the same direction
- 129 Keeping to the far left side of a road
- 131 Keeping to the left of oncoming vehicles
- 151 Riding a motor bike or bicycle alongside more than 1 other rider
- 156 Transit lanes
- 208 Parallel parking on a road (except in a median strip parking area)
- 209 Parallel parking in a median strip parking area
- 210 Angle parking
- 268 How persons must travel in or on a motor vehicle
- 270 Wearing motor bike helmets
- 271 Riding on motor bikes
- 295 Motor vehicle towing another vehicle with a towline

- 297 Driver to have proper control of a vehicle, etc.

http://www.ntc.gov.au/ViewPage.aspx?documentid=00794

Beneficiaries:

Traffic law systems are beneficial for all road users, some of them even all citizens, as they regulate what is permitted in a given infrastructure and social system. In doing this, it makes it possible to expect what is likely to happen and therefore it enhances safety.

Clear definition of the problem

Traffic law systems are made to regulate road networks and the prevailing traffic situation in a specific (e.g. European) country. In principle, they are valid for all road users, sometimes they define particular rules for specific road users like for instance motorcycle riders.

The example of the Austrian Road Traffic Act (StVO) shows that the focus of the legislatory and regulatory framework lies on cars. Motorcycles as well as other weaker road users play a minor role in this regard and are mostly treated as a minor matter. Specifically in few of an increasing number of motorcycles on European roads road traffic law must give a more differentiated view on specific road users (including motorcycles) and their needs. A Framework for Motorcycle Law would strengthen the legal situation and protection of Powered-two wheelers.

In addition, in the European member states several different road traffic laws and rules exist. A Framework for a common Motorcycle Law on EU and/or European Level could therefore be a effective tool to reduce this complexity and to facilitate common European steps to reduce accident numbers in Europe and to better coordinate concrete action towards more road safety.

Size of the problem

Practically, the size of the problem is unknown. It would be necessary to compare a state of anarchy to the highly regulated systems in place today. Most of these rules do not address a particular group of road users. There is a large number of rules affecting PTW riders, but only a rather small number addressing PTW riders exclusively.

Scientific Background

The scientific background to this measure is very general. Safe behaviour is connate only to a limited extent. Connate behaviours might hardly be relevant for correct behaviour in today's traffic system. Anthropological development created a life-form, which is suitable to be used up to an operating speed of about 30 km/h. The higher the operating speed, the less connate safety behaviours are relevant. Additional regulations are needed, when humans interact at higher speed, either with a large number of other humans, with vehicles or with the infrastructure. Traffic rules may be considered a framework of safe behaviours to compensate for short-comings of the result of anthropological development with respect to modern traffic systems.

Implementation

Traffic rules are in place everywhere in the world. In terms of implementation there are two issues that have to be considered: a) Rules are only worth to the extent they are observed. This may be considered a sort of implementation of existing rules. b) Those who are concerned may be particularly sensitive to new rules, i.e. a change to the existing system.

Expected Impact(s)

General figures cannot be provided. The impact strongly depends on the measure, the background and many other parameters. However, with implementation there's two issues that require particular attention: Those who are (will be) obliged to observe new rules have to be informed and they have to comply to these new rules, by which way ever compliance is ensured.

Acceptance

Road users who reject the existence of any traffic rule may be rare today, i.e. it may be assumed that necessity of regulations is generally accepted. There may be some different views about the necessity to comply.

Sustainability

Traffic rules in principle are sustainable. They are likely to reflect needs of a current traffic system. Changes of preconditions may require changes to the law. And laws have to be respected. If one of these two conditions is not fulfilled, sustainability suffers.

Transferability

Traffic rules in principle are transferable, which can be easily derived from the fact the each country in the world has traffic rules. Nevertheless, different rules may more or less transferable.

Costs and benefits

There's no figures on such general issues available.

Riders' perspective

★★★☆☆

(no comment)

Priorities

Practically, no priority can be given to implement a general set of traffic rules, even not if only rules are considered, which address PTW. Such regulations are there in any place of the world. However, the system of traffic rules requires great attention, it has to be maintained with respect to changes in preconditions.

Targeted Enforcement Strategies

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★★☆☆	Sustainability	★☆☆☆☆

Targeted enforcement measures involve measures that target a specific contributing factor of PTW road accidents. To achieve this successfully the enforcement measures should be integrated to a national strategy for enforcement.

It is acknowledged that the vast majority of motorcyclists are law abiding, responsible people. There is a need to protect their interests as well as the wider public and affected communities, from the minority who choose to abuse road traffic law and endanger their lives and others. These motorcyclists must recognize their responsibilities – to ride sensibly and safely within the law, be considerate to other road users and not to drive under the influence of alcohol or drugs. But police forces adopt many differing strategies when dealing with motorcyclists. This can result in a lack of focus on key safety issues and can lead to distrust and animosity amongst motorcyclists. Thus, strategies should be worked out, which focus enforcement activities on key motorcycle collision causation factors and introduce a nationally agreed approach to enforcement, with the aim of reducing killed and serious injured casualties in this most vulnerable road user group.

Example:

In the European Commission's policy orientations up to 2020, targeted enforcement is listed as one measure to increase PTW's safety. Thereby, the Member States should be encouraged to focus enforcement on speed, drink and driving, helmet use, tampering and riding without a proper PTW license.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

In the UK, the ACPO (Association of Chief Police Officers) Motorcycle Enforcement Strategy was developed in 2006. It is hoped that the introduction of clear guidelines will help to alleviate animosity between the Police and motorcycle groups, and will encourage an environment of co-operation and partnership, working together to achieve a safer road environment for all.

In general, the strategy has two main objectives:

- To reduce the number of people killed and seriously injured as a result of motorcycle collisions.
- To reduce the level of anti-social behaviour associated with a small irresponsible minority of motorcyclists that disproportionately affect the quality of life for some communities.

Amongst others, the core themes are exceeding speed limits, careless or dangerous riding and non-compliance with road signs. The results of this strategy justify this initiative: The UK casualty rate for PTW riders has fallen during the last 3 years. Whilst this strategy has not been specifically monitored, there is circumstantial evidence that the increasingly consistent approach has contributed to this reduction.

http://irsa-association.org/wp-content/motorcycle_enforcement_strategy_website.pdf

The weekender campaigns are run in conjunction with safety camera partnerships and neighboring police forces in Durham and Lothian & Borders, targeting areas of known danger to bikers. The project uses a yellow and red card system. In the Weekender campaign a “yellow card”, suggesting improvements and encouraging training, is given out to a rider making a minor mistake through a lack of skill or judgment. For some of the more dangerous or serious errors a “red card” offers a rider a chance to take part in a course to improve their skill – as an alternative to a court appearance.

http://www.northumbria.police.uk/

In America, a training guide, which targets law enforcement to specific motorcycle rider impairment behaviours, has been worked out. This training guide includes a set of behavioural cues that can be used by law enforcement personnel to accurately detect motorcyclists who are operating their vehicles while intoxicated (DUII – driving under the influence of intoxicants). Hence, these training and guidance materials help officers detect impaired motorcyclists, articulate observed behaviours on arrest reports, and support their expert testimony during legal proceedings. In this resource, 17 cues were identified that best discriminate between impaired and normal operation of a motorcycle. The cues were labelled as “excellent predictors” and “good predictors.” The “excellent” cues predicted impaired motorcycle operation at least 50 percent of the time, whereas the “good” ones predicted DUII 40 to 49 percent of the time. Amongst others, the cues include: trouble with dismount/balance at stop, turning problems, weaving, evasion, wrong way, operating without lights at night, running stop light or sign, inattentive to surroundings, erratic movements while going straight as well as recklessness.

TRB (2008). Volume 22: A Guide for Addressing Collisions Involving Motorcycles, p.V-47

Speed checks must be carried out, especially on small winding roads with a high PTW traffic volume. Drink-driving testing on motorcyclists must be carried out, as well as checks on whether the motorcyclist has the correct and appropriate driving license for the motorcycle he is riding. The suggestion of increased enforcement is because many of the motorcycle accidents are due to speeding, with alcohol in the blood and without the motorcyclist holding a motorcycle driving license.

AIB (2009). Motorcycle Accidents, p.77

FSV recommends that targeted enforcement should be planned strategically, tactically as well as efficiently. The most important enforcement measures are speed checks. They can be carried out either with mobile or stationary facilities and should focus on accident black spots and routes with a high PTW accident risk.

FSV (2010). Recommendations for the Improvement of Motorcycle Safety, p.8

According to the PROMISING project, studies in Spain and Greece have shown that riders do not wear their helmets correctly and have no interest to fulfill the legislative regulation. This should be enforced by localized police control but it is obvious that this could be no solution in general reflecting the social cost of police controls. The enforcement has to be accompanied by information campaigns to be effective, in the sense of safety improvement.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.140

Beneficiaries:

Beneficiaries can be identifies with respect to the rules that are enforced. It may be assumed that there is no group of citizens, which do not benefit at all. In some cases, it might be the riders, who shall be protected before themselves (e.g. helmet wearing enforcement, alcohol, speed, etc), other road users, residential (e.g. noise protection) or the general public in terms of crash costs.

Clear definition of the problem

The problem is that in many cases the contributing factors to an accident caused by a PTW involve breaking the highway-code such as drink and drive, exceeding the speed limit, tampering, riding without a proper PTW license etc. These factors could be eliminated if enforcement was effective.

Size of the problem

Several PTW accidents are caused because the PTW rider did not follow the highway-code.

Scientific Background

There is scientific background on several measures targeting speeding, drink and drive etc that involve all road users but not motorcyclists as a distinct group, which indicate that several enforcement measures do reduce the number of accidents and/or accident severity. However, according to our knowledge there is no scientific evidence to support the measure's effectiveness for PTW riders.

If a strategy manages to mitigate the number of traffic law offences by PTW riders, their risk rates and the rates of them causing an accident would decrease.

The measure is expected to target the identified problem to a high extent.

Expected impact

This measure if successful will have an impact on road safety.

The number of accidents caused by traffic law offences will be reduced.

There are no evaluations done in 2BESAFE that provide evidence of the impact of this measure.

A before and after study of accidents (and accident severity) as well as committed traffic law offences where PTW riders are involved can be a way to estimate the measure's success.

It could be that risk compensation effects take place. For example if there are speed cameras on one part of the route of a PTW rider, he/she might not exceed the speed limit at that part of the route but might drive more aggressively in the remaining part (speeding, making risky overtaking manoeuvres, crossing at red etc) to compensate for the increased travel time on the part where speed cameras where placed.

Implementation, Transferability

Traffic law enforcement is in place everywhere in the world. It is rather easy to put some more emphasis on planning of enforcement, on bundling or joining forces in order to target specific road user groups. This is independent from overall capacities. Even small efforts can be executed efficiently if proper planning is considered.

Acceptance

It is only natural that groups targeted by particular enforcement activities are less likely to be in favour of these activities than other groups. PTW riders will likely not be an exception to this generic rule.

Sustainability

Enforcement is an activity undertaken to improve sustainability of legal provisions. But even enforcement can be done in a more or less sustainable way. One of the basic rules: Warnings or punishment should take place shortly after an offence. Personal contact is more effective than tickets sent by mail (Knoflacher, 2005).

Costs and benefits

Elvik et al (2009) have summarised 13 evaluation studies on enforcement measures. None of these studies explicitly targets PTW riders. For three of these studies, impact on accidents was not observed, in four cases, no safety impact was found. Alcohol interlocks in heavy vehicles was not efficient, but for the remaining six measures, positive benefit-cost ratios were found.

Riders' perspective

☆☆☆☆☆

The riders' associations strongly oppose this measure if it leads to discrimination against riders. Enforcement strategies should be fair and focused equally on all road users in order to maintain the confidence of the public in the police forces. They should focus on known accidents factors with the objective of reducing casualties, and not on minor infringements with the goal of imposing fines only.

Priority

The term "targeted" enforcement leaves a taste of discrimination to PTW users, which can be clearly seen in the riders' statement. But even if riders are the target of one particular activity, this does not necessarily mean that other road users are not target to other targeted enforcement. It "targeted" is an expression for an advanced level of planning, joining forces and coordination, such activities may be assumed to be more efficient than "business as usual".

Filtering

Expert Assessment			
Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★★☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★★☆
Safety impact	☆☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★★★

In broad terms, filtering by motorcyclists is defined as moving between traffic when other surrounding traffic is stationary. Especially in front of intersections, PTW riders are allowed to pass other vehicles that have already stopped. It is also quite common that riders pass stationary queues on highways.

Example:

E.g. on urban highways in and around Paris - although this behaviour is illegal - there is a culture where car drivers open a kind of PTW lane.

In Austria, filtering in order to stop in front of other vehicles is regulated in the national guideline Austrian Road Traffic Act from 1960 - Bundesgesetzblatt 1960/159 updated by 2006/152, originally published in 1960 by the Republic of Austria. Paragraph 12 says that if there is enough space, cyclists and PTW riders are allowed to pass (left and right) other vehicles to position in front of them. Filtering was first allowed for bicycle only. No severe incidents occurred; it was later extended to PTW. Practically this was nothing but to legalize common practice.

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10011336

Besides, this motorcycle rider behaviour is also tolerated by the authorities in the Netherlands, France, Italy and Great Britain.

Noordzij P.C. et al. (2001). Integration of needs of moped and motorcycle riders into safety measures, p.149

Beneficiaries:

This measure improves mobility by PTW riders, but puts additional burden to car drivers, since, as soon as filtering is allowed, they have to take care when they open the door in a traffic jam.

Figure 72: Filtering[67]

Clear definition of the problem

Filtering is not a measure, it is behaviour which can be either legal or not. It mainly improves PTW mobility. Safety may be affected. Talking about a "measure" would be making filtering legal.

Size of the problem, Scientific Background

The size of the problem can neither be identified by accident statistics nor are there studies available, to which extent of their mileage PTW riders are filtering. It is quite obvious that filtering increases traffic capacity (Sermpis et al., 2005). But no information is provided at a scientific level, to which extent filtering reduces PTW riders' travel times.

Implementation

It is rather easy to allow filtering, but collateral effects have to be considered. The lane width should be adequate. Obviously, there is an additional risk of riders colliding with cars due to misjudgement on available space or loss of control. Lane change manoeuvres are not an issue since cars have to stationary (see also "Lane Splitting"). Problems may occur in the moment the queues of cars start moving again. The Austrian regulations do not explicitly address this issue. Filtering might be supported by also implementing Advanced Stop Lines, which offer space to riders in front of intersections.

Expected Impact(s)

No scientific evidence is available, however it is quite obvious that filtering reduces travel times of riders, but comprises an additional risk.

Acceptance

Filtering may be considered common practice almost everywhere. It offers advantages to riders, potential additional risk has to be considered, as insurance companies might be affected as well as other road users, which would certainly have to adapt their behaviour and would potentially face new responsibility for lane change manoeuvres or opening doors of their vehicles.

Sustainability

There is no risk of fading effects, it is just the opposite with time PTW riders and other road users will become more familiar with this practice and their interaction behaviour will improve.

Transferability

This measure could be implemented anywhere, but it makes sense mainly in areas where the queues are quite long.

[67] Source: FEMA (2007) A European Agenda for Motorcycle Safety, p.31

Costs and benefits

Evidence on impacts (travel times, safety) could not be found.

Riders' perspective

★★★★★

The riders' associations strongly support this measure as it greatly contributes to reducing congestion and emissions, while increasing safety for all road users by creating a clear framework for sharing the road that is well understood by all drivers.

Priorities

Filtering is common practice, which in many places is illegal. Hence a "measure" could be to make it legal. Although there is no scientific evidence, filtering is likely to significantly reduce PTW travel times in particular in congested urban environments. Concerns about safety have to be taken into account and potential additional risk has to be addressed before implementation. Expert ratings suggest that the measure is highly sustainable and easy to implement, but there seem to be concerns about safety.

Lane Splitting

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★★☆
Safety impact	☆☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	★★★★☆

Lane splitting is defined as moving through traffic when other traffic is in motion. It can also refer to overtaking within the same marked lane in moving traffic.

Example:

According to the Australian Road Rules, a rider of a PTW must not ride alongside more than one other vehicle, unless the rider is overtaking the other vehicle. If the other vehicle is a PTW, the rider might get a special permission to ride alongside another rider (see “Motorcycles operating two abreast in same lane”).

http://www.ntc.gov.au/filemedia/Reports/ARR_February_2009_final.pdf

Beneficiaries:

On the one hand, lane splitting helps to reduce the travel time for PTW as they don’t have to move into the adjacent lane to overtake. Besides, lane splitting decreases the chances of rear end collisions. On the other hand, due to the very close distance when passing, the crash risk is increased.

Clear definition of the problem

Lane splitting is not a measure, it is behaviour which can be either legal or not. It mainly improves PTW mobility. Safety may be affected. Talking about a "measure" would be making lane splitting legal.

Again there is no problem safety-wise, however this measure reduces PTW travelling times especially under dense conditions (i.e. congestion). Depending though on the behaviour of PTW riders and other drivers there can be an effect at road safety with the reduction of rear-end collisions and the increase of side collisions.

Size of the problem, Scientific Background, Expected Impact(s)

There is no problem from the safety point of view. This measure is likely to reduce PTW travelling times especially under dense traffic conditions (Sermpis et al., 2005). On the other hand, a safety problem may appear. It is likely that unexpected lane change manoeuvres by other road users exert additional risk to PTW riders.

Implementation

It is rather easy to make lane splitting legal, but collateral effects have to be considered. The lane width should be adequate. Obviously, there is an additional risk of riders colliding with cars due to misjudgement on available space or loss of control. Lane change manoeuvres are not an issue since cars have to stationary (see also "Lane Splitting"). Problems may occur in the moment the queues of cars start moving again. The Austrian regulations do not explicitly address this issue. Lane splitting might be supported by also implementing Advanced Stop Lines, which offer space to riders in front of intersections.

It has to be clearly defined, who is responsible in case of crashes between PTW riders splitting lanes and the other vehicles they are passing by. Existence of adequate lane width, PTW conspicuity, behavioural and other legal issues should be investigated before the implementation of the measure. This measure should probably be avoided in roads where vehicles travel at high speeds.

Quite likely, implementation would have to be flanked by awareness campaigns and changes in driver education.

Acceptance

Riders will likely be in favour of being allowed to split lanes legally. If they are not, they have a choice.

There may be concerns among those who are worried about additional accidents and having to cover the damage in case. This may also be an issue for policy makers, since they have to prioritise between improvement of mobility and a potential decrease of safety.

Other road users might not care for PTW mobility increase. However, if evidence is shown that this measure increases road capacity they might be persuaded. There is probably no argument to persuade that PTW mobility is an issue more important than complex driving situations.

Sustainability

There is no risk of fading effects, it is just the opposite with time PTW riders and other road users will become more familiar with this practice and their interaction behaviour will improve.

Transferability

This measure could be implemented anywhere, but it makes sense mainly in areas where the queues are quite long and the proportion of PTWs in the traffic composition is also high.

Costs and benefits

Evidence on impacts (travel times, safety) could not be found.

Riders' perspective

★★★☆☆

The riders' associations strongly support updates in traffic law to cover this point and establish a set of clear rules, understood by all drivers that allow motorcyclists to safely overtake or split through lanes of slow-moving or stationary traffic.

Priorities

Lane splitting seems to be common practice almost everywhere around the globe. However, in most places it is illegal. Making lane splitting legal receives very low appreciation by experts, even the riders' statement is careful. This may be due to the fact the there will be difficult problem in distribution of responsibilities for crash avoidance and priority rules for interaction between car drivers and PTW riders moving among them. Safety is also an issue; strong discipline is required from both riders and drivers to comply to rules, which may be implemented to reduce the potential risk of lane splitting.

Motorcycles Operating Two Abreast in Same Lane

Expert Assessment			
Overall		★☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★★★
Safety impact	☆☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★★☆☆

Compared to lane splitting, which refers to overtaking within the same marked lane in moving traffic, riding a PTW alongside more than one other rider represents a more permanent status.

Example:

In the United States, only Vermont and Virginia specifically forbid motorcycles to ride two abreast. The states of Delaware, Idaho, Illinois, Kentucky, Mississippi, Missouri, New Jersey, New Mexico, Texas and West Virginia have no statutes against riding abreast and all other states allow up to two riders to ride abreast.

http://www.bikerplaza.com/motorcycle-law.html#CO

The Australian Road Rules say that the rider of a motor bike or bicycle must not ride on a road that is not a multi-lane road or in a marked lane alongside more than one other rider, unless the rider is overtaking the other riders; or permitted to do so under another law of this jurisdiction. In case of permitted riding alongside another rider, the rider must ride not over 1.5 meters from the other rider.

http://www.ntc.gov.au/filemedia/Reports/ARR_February_2009_final.pdf

In Austria, riding a PTW alongside more than one other rider is not decidedly forbidden, but the restriction results from various paragraphs (paragraph 7 – general road rules, paragraph 15 – overtaking and paragraph 18 – keeping distance).

http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10011336

Beneficiaries:

Common use of one lane by more than one rider may be an issue on urban, congested roads in order to make traffic more efficient. In rural areas, this may be an issue for larger groups of riders moving at relatively low speed on straight road sections.

Figure 73: Motorcycles operating two abreast in the same lane[68]

Clear definition of the problem

Compared to lane splitting, which refers to overtaking within the same marked lane in moving traffic, riding a PTW alongside more than one other rider represents a more permanent status, which does not increase road capacity at the same extent, but in certain cases (urban areas) could be safer.

[68] Source: http://www.triumphrat.net/ride-trip-reports/105243-grumpy-at-ciudad-victoria-mexico-bike-rally.html, 14 Sep.2010

Size of the problem, Scientific Background, Expected Impact(s)

In terms of urban traffic, this "measure" is similar to lane splitting and filtering. There may be some advantages in terms of road capacity, but no scientific evidence is available. It could improve PTW conspicuity in rural areas or high speed roads. For some riders, moving side by side on one lane might make a journey more enjoyable when the PTW riders belong to a group. It might be risky to move side by side on winding roads, riders might even not be in favour of riding this way.

Implementation

Practically, implementation is rather easy; it only requires slight changes to the road code. Awareness should be raised about potential risks and driver training would have to consider this kind of riding.

Acceptance, Transferability

If riding side by side is made legal, riders are still free to do it or not. Safety might be a concern for those having to cover potential additional damage.

Sustainability

No fading effects are expected from the implementation of the measure.

Costs and benefits

Evidence on impacts (travel times, safety) could not be found.

Riders' perspective

★★☆☆☆

The riders' associations strongly support updates in traffic law to cover this point and establish a set of clear rules, understood by all drivers, on riding abreast on the same lane and ride in groups.

Priorities

The expert ratings could be understood as there is no striking problem to solve, even the riders award only two stars.

Vehicle Identification Number

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	★★☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★☆☆☆

This measure involves inserting specific markings for different vehicle classes that specify the vehicle's characteristics. The marking of vehicles is regulated on EU-level and on the level of national authorities. All vehicles must have a manufacturer's data plate and markings (vehicle identification number). The detailed specifications are regulated on a national level and have to be reported to the EC. The directive regulates the composition of data plates and vehicle identification numbers.

Example:

The marking of vehicle classes is regulated in the transnational direction “Statutory markings for two or three-wheel motor vehicles - 93/34/EEC” and it was implemented in 1993.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0034:EN:NOT

Beneficiaries:

The Vehicle Identification Number (VIN) can be used for a number of purposes. For some cases, the vehicle owner will benefit (re-identification after theft, orders for spare parts), in other cases, enforcement bodies are concerned (detection of tampering, periodic inspection).

Figure 74: Marking[69]

Clear definition of the problem, Expected impact

The VIN is a unique identifier to a certain vehicle. Manufacturers keep records about the vehicles, they can identify which spare parts are suitable, or they may provide information about the history of a vehicle, in case this is an issue (e.g. for historic vehicles). Technical and enforcement bodies also have the possibility of identifying a single vehicle and acquired additional information for detection of tampering or periodic technical inspection.

Size of the problem, Scientific Background

For all purposes the VIN can be used, a positive impact may be assumed, but there is no evidence about the contribution of the existence of a VIN in terms of saving time or work more accurately.

Implementation, Transferability

Implementation of a VIN is rather easy, respective regulations are in place in Europe for decades. Records have to be kept by the manufacturers. All major manufacturers are operating world wide.

If the VIN is used for registration, the respective databases have to be adapted.

Acceptance

No argument against using a VIN could be found.

Sustainability

The measure is expected to be sustainable.

Costs and benefits

Evidence on impacts could be found.

Riders' perspective

★★★★★

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

The measure is already implemented for mopeds and motorcycles in EU countries. Low priority should be given to implementation for other PTW classes.

[69] Source: http://www.bmwarchiv.de/vin/bmw-vin-decoder.html, 30 Jul. 2009

Measuring Power and Speed

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	★☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	★★★☆☆

This measure defines standardized instructions how to measure the maximum design speed, maximum engine torque and the net maximum engine power of PTWs.

Example:

The methods for measuring the maximum net engine power and the maximum speed are defined in the directive 95/1/EEC of the European commission which was published in 1995.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31995L0001:EN:NOT

Beneficiaries:

Reliability of this technical information offers some benefits to consumers and authorities and may be considered an issue of fair competition on the market.

Clear definition of the problem

There have to be clear instructions how to measure the speed and power of PTWs. Otherwise, neither public authorities are able to determine how vehicles fit into the legal system nor can PTW riders fully rely on the manufacturer's data. Without standardized testing, they could not be sure if the PTW had really the power and speed as specified by the manufacturer because they would not know how it was tested.

Size of the problem

The size of the problem cannot be quantified.

Scientific Background

This is less a scientific than a legal problem. Science found that mayimum power does not statue an intrinsic risk. Although there are indeed differences in risk, these differences ar induced by the mode of use and the riders using high-power motorcycles.

Expected impact

This measure will have an impact on safety and environment.

Potential buyers will be safe in the knowledge that the manufacturer's measurements concerning the PTW's power and speed comply with the European standards. This measure has an impact on public authorities, too: This way, it is easy to determine how the PTWs fit into the legal system of a country. This measure also has an effect on enforcement activities as the police have instructions how to check PTWs with respect to their speed and power in the course of roadside testing. Hence, they can easily detect tampered PTWs (if the measured maximum speed is higher than the specified maximum speed). By minimizing tampering, PTW collisions due to speeding as well as emissions (noise and exhaust) caused by higher engine speed and/or fuel feed can be reduced. Manufacturers benefit from this measure, too, because it leads to a harmonization of the European automotive market.

Side effects cannot be expected.

Implementation

In the European Union, measurement is standardized within Commission Directive 95/1/EC.

Acceptance

It is unlikely that this measure is not accepted because testing standards are normally developed by the industry as well as public authorities.

The public is not affected by this measure.

Sustainability

It is not believed that there is the risk of fading effects.

Transferability

Similar legal provision can be taken anywhere, but this requires a vital system of type approval and respective test centres.

Costs and benefits

No information available.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

It is clearly necessary to have a standard on measurement of various properties of a vehicle. It is an issue of fair competition on the market, consumer protection and efficiency of enforcement. These rules are in place in Europe for decades, there are no arguments provided to change these rules, which may be the reason for very low ratings by experts.

Safety Cameras

Expert Assessment			
Overall		★☆☆☆☆	
Size	★★☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★★☆☆☆
Safety impact	★★☆☆☆	Acceptance	☆☆☆☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

This measure involves the installation of safety cameras through which speeding and red light running offenders can be monitored and fined. Enforcement through these cameras can reduce such offences. In general, there are two types of safety cameras: Speed cameras as well as red light cameras. Both are installed at sites with a history of fatal and serious injury caused by speed respectively by red light running.

Example:

The London Safety Camera Partnership exists to reduce death and serious injury caused by speeding and red light running and to raise awareness about its dangers and. Besides, it should help to meet the Government and the Mayor's 2010 targets for casualty reduction. To achieve these aims the Partnership operates a combination of fixed speed, mobile speed and red light camera sites across London, making it a safer place for everyone. After three years, collisions involving PTWs at fixed speed camera sites identified from casualty data were reduced by 30%. At red-light camera sites the reduction was 14%.

http://www.lscp.org.uk/?homepage

In Barcelona, 10 cameras were installed at 30 conflictive signal-controlled crossings of the city. The sites were selected via a Risk Zones Application (RiZA) that links accident data with a geographic database that is used by a team of police involved in preventative and remedial actions. Overall, a reduction of 22% in collisions has been registered at junctions with cameras over a period of four months.

Beneficiaries:

These systems address a key urban PTW collision type and thus decrease the total number of PTW accidents in urban areas.

Clear definition of the problem

Speeding and red light running are offences that are rather often in vehicular movement and also within PTWs. In specific countries red light running in certain junctions by PTWs is the law rather than the exception. Such offences however are important risk factors causing accidents.

Size of the problem

Speeding and red light running are important contributing factors in PTW accidents.

Scientific Background

There are studies that indicate that the installation of safety cameras resulted in less offences and also PTW accidents.

Enforcement through safety cameras in locations where speeding and red light running is a common phenomenon and there is a high number of accidents will reduce the number of offences and hence the number of accidents (and also accident severity in the case of speeding) that are caused from these offences.

Expected impact

Elvik et al (2009) summarises a couple of studies on different application of safety cameras. Stationary speed enforcement is very likely to reduce accidents, at least 10% reduction of injuries and a maximum of 39% reduction of fatalities can be expected. Red light cameras seem to increase the number or rear end collisions but a decrease the overall number of crashes; these results are not significant. These results do not particularly address PTW.

Implementation

In case there are many sites with accidents caused by PTW speeding or red light running the cost might be quite high.

The location of the cameras should be carefully decided. It should involve places where offences take place often but also accidents due to these offences take place. Personal information issues should be cleared before implementation.

Cameras should be visible so that the riders do not speed or cross at red light, since the aim is not to fine riders but to improve their behaviour. Another way is to hide the cameras, but to have informative signs that there are safety cameras operating in the area.

Acceptance

By nature, riders do not appreciate this measure, although, strong resistance cannot be expected as red light running and speeding are illegal and generally considered very dangerous. Enforcement bodies may appreciate new opportunities, but sometimes the use of new technologies raises some resistance. Costs have to be considered, in particular if there are no benefits from fine for the organisation covering the investment and personal costs for operation.

Sustainability

For stationary devices, sustainability may be considered low, since road users know well, where they are observed. Speed cameras normally generate an impact on s short road section, red light cameras only at one intersection.

Transferability

Safety cameras can be used anywhere, however, the infrastructure needed for operation has to be built up and personal has to be properly training in using the equipment.

Costs and benefits

Due to a lack of effects, no benefit-cost figures are available for red light cameras. Stationary speed enforcement is highly beneficial, benefit-cost ratio was found between 2 and 27. These figures do not particularly address PTW (Elvik, 2009).

Riders' perspective

☆☆☆☆☆

The riders' associations oppose this measure insofar as it replaces human decision by automated enforcement. Automated law enforcement is detrimental to the public trust in the system, does not allow for sensible appreciation of the conditions in which an infringement has been spotted, and can have serious adverse effects on driver behaviour (for instance, multiple documented cases of drivers refusing to clear the path for emergency vehicles by fear of triggering an automatic speed or red light camera).

Priorities

Although speeding is considered a major problem, safety cameras as a means of encountering speeding are appreciated by the experts.

Anti-Tampering Measures and Enforcement

Expert Assessment			
Overall		☆☆☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	★★☆☆☆	Acceptance	★☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

This measure involves legal regulations for anti-tampering as well as effective enforcement to minimize after-sale PTW tampering. The issue of after-sale tampering with mopeds and motorcycles is regarded as a serious problem in some EU states. The addition of performance enhancing items and tampering with equipment designed to restrict power output can compromise the safe operation of some PTWs. Especially PTW engine driveline tampering – to increase performance above legal limits – is a major concern in several European countries. Therefore, measures concerning tampering should be undertaken.

Example:

Anti-tampering measures for two-wheel mopeds and motorcycles are laid down in chapter 7 in the Directive 97/24/EC, which deals with certain components and characteristics of two or three-wheel motor vehicles. In chapter 7, general provisions as well as specific requirements for vehicles in categories A (mopeds) and B (motorcycles with a cylinder capacity not exceeding 125 cc and a power not exceeding 11 kW) are stated.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0024:en:NOT

The issue of tampering is also addressed in the European Commission's road safety policy orientations up to 2020. It is suggested that the research and technical development of appropriate anti-tampering measures should be encouraged. Besides, the Member States are encouraged to focus enforcement on tampering.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

ACEM is in favour of adopting measures preventing moped users from illegally raising the maximum speed of the vehicle and proposes further anti-tampering devices complementing the existing regulatory provisions. These new measures would cover electrical devices participating in the vehicle's maximum speed limitation, the interchangeability of components, the Continuously Variable Transmission's components, the exhaust silencing system and marking.

ACEM (2008). A Safety Plan for Action, p.15

In Madrid, a campaign has been developed as a counter-measure to this practice of illegal moped and motorcycle tuning. Mobile speed cameras and dynamometers have been supplied to law enforcement units to allow them to carry out campaigns that monitor compliance with technical requirements for two-wheeled motor vehicles. The aim of this initiative is to combat motorcycle and moped tuning to increase power and speed.

http://www.madrid.es/

FEMA cannot see any road safety benefits from restricting the historic tradition of modifying motorcycles. In the European Agenda for Motorcycle Safety, FEMA argues that the quality and safety of aftermarket components have steadily improved and are in some cases significantly superior to equivalent standard components. Besides, the relatively simple design of a motorcycle and the availability of "bolt-on" replacement or accessory components make it easy and popular to modify. Therefore, some skilled motorcycle owners take modification even further and design and produce the components themselves. This approach has brought about innovative, highly functional designs, sometimes adopted by the motorcycle industry and used on standard, mass-produced motorcycles. Accordingly, anti-tampering measures would produce negative side-effects such as limiting the access of riders to superior tires, brakes, suspension, and other components.

FEMA (2007) A European Agenda for Motorcycle Safety, p.41

Beneficiaries:

As tampering is a risk factor, moped as well as motorcycle accidents due to speeding can be reduced by minimizing tampering. Besides, compromised rider safety due to vehicle defect caused by tampering can be sorted out.

Clear definition of the problem

The issue of after-sale tampering with mopeds and motorcycles is regarded as a serious problem in some EU states. The addition of performance enhancing items and tampering with equipment designed to restrict power output can compromise the safe operation of some PTWs. Especially PTW engine driveline tampering – to increase performance above legal limits – is a major concern in several European countries. Therefore, measures concerning tampering should be undertaken.

Size of the problem

Modifying PTW instrumentation to allow an increase in PTWs performance is not safe and could is a contributing factor for PTW accidents. This problem mainly concerns mopeds.

Scientific Background

There is no such scientific evidence according to our knowledge.

Usually tampering aims at riding at higher speeds than the PTW can support. Hence, a measure targeting anti-tampering could reduce the accidents and accident severity involving PTWs riding at speeds higher than their other technical characteristics allow.

Expected impact

The measure is expected to improve road safety, but scientific evidence on the impact on safety could not be found. If there is an impact it is to both accident counts and severity.

Implementation, Transferability

There is only one particular challenge in implementing anti-tampering measures: This requires staff with very specific knowledge and experience, integrating the abilities of a police detective, a mechanic and an electronic engineer.

Acceptance

Tampering is a kind of hunting game or competition between those who tamper and the ones to detect it. However, it is generally considered to be dangerous. Even if there might be resistance, there are little arguments for objections.

Sustainability

The measure is considered to be sustainable, as long as it is applied and enforcement personal is well-trained for being able to catch up with the offenders' creativity.

Costs and benefits

No data available according to our knowledge.

Riders' perspective

★★★★★

The riders' associations accept that anti-tampering measures can be required for mopeds and A1-class motorcycles (125cc) since elements such as brakes, tyres and steering are all designed to operate under the designed maximum speed and would not function properly at higher speeds after engine or power train modifications. However, riders strongly oppose anti-modification for motorcycles with an engine size over 125cc as the measure has no proven safety benefit, creates an additional cost for the manufacturer and therefore for the consumer, and makes it impossible for riders to install aftermarket elements necessary to improve their comfort (e.g. adjustment of footrests and seat to the rider's height, better windshield, heating grips), their safety (better brakes, better brake discs, better shock absorbers) and their motorcycle's fuel economy (better clutch, better gearbox, and better engine mapping chips).

Priorities

Tampering should be combated; even the riders confess there are certain risks in particular with low-power vehicles. However, such activities are worth nothing without properly trained staff.

Periodical Technical Inspections

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★★★
Total impact	★★★★★	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

The measure involves PTW technical inspections becoming mandatory (wherever they are still not). If every PTW is mandatorily tested periodically by an authorized company, PTW safety will increase due to these technical checks: On the one hand, the PTW's roadworthiness is tested and on the other hand, attempts concerning illegal tampering can be revealed. Because of this, in most EU Member States, periodical technical inspections are already carried out.

Example:

As mentioned in the policy orientations, the European Commission will propose to extend to PTWs the existing EU legislation concerning roadworthiness testing.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

In Northern Ireland, roadworthiness testing is carried out annually (three years after the vehicle has been registered for the first time). This test, also known as MOT (Ministry of Transport) test, is carried out by a government agency at designated testing sites. In Great Britain (England, Scotland and Wales), there is a completely different system in which MOTs are carried out by private companies, which have the required approval.

Baird T., Hardy E. (2010) Response to DG Enterprise regarding Framework Regulations for L vehicles, p.6

That tampering is a major problem concerning motorcycle safety was shown in the report “Study on Anti Tampering devices relating to Two or Three Wheeled Motor Vehicles”, which was published by TÜV in 2003. The authors of this report produced an estimation of the magnitude of the manipulations can be found in statistics and estimations of some (German) inspection services in the member states, in which these vehicles are subject to periodic technical inspection. The percentage of faults found there was about 5%.

http://ec.europa.eu/F2535706-5908-454F-AF0B-9D8019088FD9/FinalDownload/DownloadId-E8B121300518D21647ECE0207738C16F/F2535706-5908-454F-AF0B-9D8019088FD9/enterprise/sectors/automotive/files/projects/report_anti_tampering_devices_en.pdf

Besides, MAIDS confirms that lack of proper vehicle maintenance is a contributing factor in PTW accidents (5% of all PTW contributing factors). Periodic inspections reduce the incidence of safety related defects to tires, brakes and lights, particularly those of which the owner is unaware of and are likely to discourage tampering of mopeds. ACEM therefore supports the inclusion of PTWs in the scope of Directive 96/96/EC.

ACEM (2008). A Safety Plan for Action, p.14

In contrast, FEMA is a huge opponent of compulsory roadworthiness tests and argues as follows:

- Independent studies put the safety benefit of testing regimes into question.
- Technical failures only account for 0.3% of all primary accident contributing factors. It is doubtful that an extension of testing regimes would be able to reduce this number significantly.
- Countries in Europe having testing regimes for PTWs do not show improved accident figures.
- FEMA is of the opinion that PTW riders are more aware of the technical condition of their vehicle because most technical problems directly impact riding conditions and require instant action. Besides, the vast majority of riders are well aware of the risks related to riding a PTW and are clearly more safety conscious than most car drivers. Hence, awareness campaigns, targeting riders having a less passionate relationship with their PTW, are able to further decrease the small fraction of accidents caused by technical failures.
- Geographical considerations have to be taken into account: in less densely populated EU regions, a considerable amount of time is needed to reach a testing centre. Road conditions also vary from one state to another, impacting the specific needs for periodic inspections.
- As for the environment, the testing of exhaust emissions is not up to date. There is no harmonized testing methodology allowing exhaust emissions to be assessed consistently.

FEMA (2010). Position Statement On Periodical Technical Inspections / Road Worthiness Testing, p.1

Beneficiaries:

Mandatory testing of every PTW addresses the vehicle categories motorcycle and moped in order to increase PTW safety. As failures are discovered, PTW accidents caused by technical defects can mainly be avoided.

Clear definition of the problem

One contributing factor for road accidents is the vehicle. This means that an accident is caused or not being avoided or is more severe due to vehicle technological defects (e.g. brakes not functioning as they should). If the owner of a PTW is not aware of the defects and does not take it for technical inspections such accidents will still take place.

Size of the problem

Technical failures only account for 0.3% of all primary accident contributing factors.

Expected impact

This measure will have an impact in road safety and environment.

The measure is expected to reduce the number of accidents (and/or accident severity) where one of the contributing factors was a vehicle defect. In addition, it is also expected to reduce environmental pollutions caused by PTW emissions.

It may be considered that there are large numbers of unreported cases, in many countries there is no systematic technical inspection of vehicles after crashes in place, actually there could no country be found, where such a system is in place, neither for property-damage accidents nor for injury accidents.

Hence, neither the true size of the problem nor the expected impact can be determined. DEKRA annually publishes reports on technical inspection of vehicles after crashes. They report about 1/3 of vehicles being found with severe defects, if which about one fourth is relevant to the crash. Hence, in total it is less than 10% of the vehicles found with defects relevant to the crash. Mod of them are defects of tyres and brakes. However, this sample is highly biased. Such technical inspection is only executed if there is a recognisable suspect of technical failure being the reason for a crash.

Implementation, Transferability

There are regulations at European level about how and how often to execute periodic inspection. These rules proved to be effective. However, periodic technical inspection requires a large number of well-educated staff and huge investment to infrastructure for vehicle testing. Turkey has recently implemented technical inspection. Turkish administration contracted a private company to set up the system.

In terms of PTW, it is unknown to which extent PTW are defective. For mopeds and smaller motorcycles in particular, periodic inspection is a strong means to avoid tampering.

Acceptance

In Europe, it is more or less accepted, that "dangerous machinery" has to be maintained and properly inspected to remain technically fit during its lifetime. The lack if precise data on technical failure as contributing factor to safety might limit the acceptance of having one's vehicle regularly inspected.

Sustainability

No fading effects are expected.

Costs and benefits

No data available, which addresses PTW.

Riders' perspective

★★★★★

The riders' associations strongly oppose any extension of periodical technical inspections schemes, because it would only represent an additional cost without any added safety benefit: PTWs already undergo manufacturer-recommended maintenance at least once a year; and technical failures are a factor of less than 1% of PTW accident, most of which are attributable to tyre bursts which would not be prevented by an inspection every two years.

Priorities

Although it may seem of course to have one's vehicle regularly inspected, there seems to be no good argument in putting high priority onto extending the system of technical inspection in Europe. Nevertheless, such a system should be in place anyway. The fact that less than 1% of crashes are related to technical failure is a strong proof that the European system is effective.

13. Road Safety Education and Campaigns

Road Safety campaigns can improve the safety of motorcyclists. Rider attitudes and perception of motorcyclists are the targets of most campaigns. Therefore, education and publicity actions should be adjusted to the different target groups, e.g. urban riders, teenage moped and scooters riders or leisure riders. Interventions, involving publicity or education are the three most utilized campaigns combined with engineering and/or enforcement.

Signposts, Displays, Roadside Boards and Bills Alongside Dangerous Roads

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★★★☆☆
Total impact	★★☆☆☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★☆☆
Efficiency	★☆☆☆☆	Sustainability	☆☆☆☆☆

Signposts and bills remind motorcyclists of dangerous situations alongside highly frequented motorcycle routes.

Example:

In Tyrol, Austria, locals as well as foreigners enjoy the winding mountain roads. Unfortunately, many motorcyclists were involved in accidents on these routes and in the year 2006, 10 out of 15 fatalities were people from neighbouring states. Hence, KfV and its partners designed new signposts displaying guardian angels and bills to indicate the risks especially for foreign riders. Additionally, “white angels” on motorcycles handed out information brochures, where dangerous motorcycle routes were marked.

http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/tirol/aktionen/

Leicester, Leicestershire and Rutland Safety Camera Partnership’s “Blind Faith” campaign features an eye-catching display depicting a crashed motorcycle. Near to the display a stand is situated, where the riders can take training.

IHIE (2005). IHIE Guidelines for motorcycling- improving safety through engineering and integration, p.61

The Gloucestershire Country Council created a series of roadside boards featuring the “fatal four” for motorcycle riders: speed, control, corners and overtaking.

IHIE (2005). IHIE Guidelines for motorcycling- improving safety through engineering and integration, p.63

The South Gloucestershire Council installed temporary road signs near motorcycle accident problem sites. In sets of three, the signs warned drivers to watch out for motorcycles and reminded them that motorcyclists used the road, too. The third sign shows the number of motorcycle accidents in the vicinity.

http://www.southglos.gov.uk/NR/exeres/f6df326d-9d5c-4309-9924-38b5d4897f75

Within the Austrian campaign “Bikersproject”, satirical and provoking signposts were designed. They contain cartoons and verses in the style of Wilhelm Busch. Also radio spots and brochures were created to remind motorcyclists of keeping reserves for unpredictable risk situations. Emphasis was also placed on guard rails and on hazard areas.

http://www.bikersproject.at/

Beneficiaries:

Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

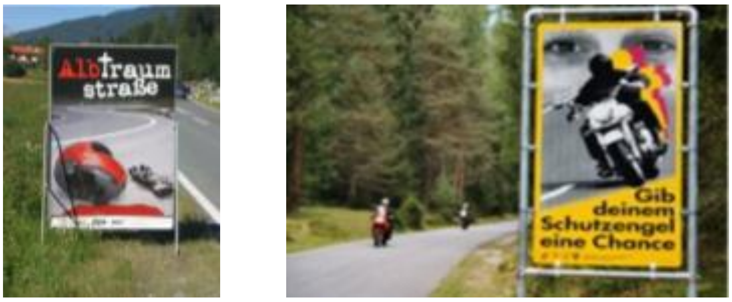

Figure 75: Signposts designed by KfV[70]

Figure 76:"Fatal Four" for motorcycle riders[71]

Figure 77: Road signs installed by the South Gloucestershire Country Council[72]

Figure 78: Signposts designed for "Bikersproject"[73]

Short Description of the measure

Non-mission-critical roadside information, particularly on dangerous roads where margins for error are smaller, has the potential to distract a rider with a resultant threat to rider safety. A further threat to the

[70] Source: http://www.kfv.at/kuratorium-fuer-verkehrssicherheit/landesstellen/tirol/aktionen/, 12 Aug. 2009
[71] Source: IHIE Guidelines, Chapter 7
[72] Source: IHIE Guidelines, Chapter 7
[73] Source: http://www.vsicher.at/bp05/kampagne/kampagne-archiv/Plakatx.jpg, 17 Aug. 2009

PTW rider is the distraction caused to other road users whose distracted driving may produce unpredictable behaviour that may also threaten PTW rider safety.

Advertising in particular is designed to attract the attention of any passer-by whether as a pedestrian or using vehicular transport. A responsible advertising policy would consider the potential impact of its presence on those whose attention may be drawn by the advertising.

Clear definition of the problem

The problem of Signposts, Displays, Roadside Boards and Bills alongside Dangerous Roads is that road users attention may be drawn away from the tasks required for safe riding, driving or road use such that collision risk is increased.

This might be due to distraction of the rider directly – drawing the rider's attention away from the activities require for safe driving may result in the rider failing to attend to a critical occurrence that results in an increased risk of a collision.

It may also be due to distraction of a third party that places the rider at risk (e.g. a distracted truck driver with erratic steering; a distracted pedestrian failing to check if it is safe to cross the road)

Size of the problem

Roadside information of the type described is aimed at drawing the attention of the maximum number of observers to the displayed product or service. Consequently, they tend to be placed in busy areas. Whilst a greater density of traffic and pedestrians may in itself raise collision risk, the addition of further distractions increases this risk further.

In 2009, in the UK there were 1,806 recorded road accidents causing injury to one or more people in which distraction outside the vehicle was judged to be a contributory factor. Of those, 120 were by motorcycles (compared to 1,477 by cars), comprising less than one percent of all recorded road accidents involving a motorcycle – although this may be an underestimate as it may be difficult to determine or prove that a driver or rider involved in such an accident was distracted by an external object.

Scientific Background

There is a relative dearth of research papers that have specifically studied rider distraction by external displays.

Wallace (2003) produced a frequently cited review of driver distraction by external displays stating that this phenomenon may be a factor in more than 10% of road accidents but that the risk of distraction is highly situation specific.

Implementation

Wallace (2003) concluded:

Many billboards and signs may have no measurable impact on road safety, but there is overwhelming evidence that, at least in some situations, signs and billboards can be a threat to road safety.

Almost all studies agree that too much 'visual clutter' at or near intersections and junctions can interfere with drivers' visual search strategies and lead to accidents.

It is probable (although it has not yet been proven), that drivers can be distracted by isolated, illuminated signs and billboards by the side of the road in an information-poor ('boring') driving environment.

Expected Impact(s)

This area has an impact on safety in that sign clutter and distraction by external displays may raise the risk of collisions.

This area also has an impact on the environment in that billboards and sign clutter may be seen as less aesthetically pleasing.

It would be naïve to believe that it will be possible to remove all advertising and extraneous displays from the roadside. However, there is an opportunity to consider the location, size and content of signs and advertising such that their impact on safety is reduced.

The 2 BE SAFE does not have an explicit objective to examine distraction by external displays. It may be possible (though difficult) to examine whether adverse events (such as harsh braking or sudden steering) were more commonly recorded in the vicinity of external displays.

Acceptance

Placing signposts along motorcycle routes may be opposed by infrastructure providers or local administrations. They might argue about the overall safety impact considering benefits for the target group and side effects in terms of distraction to the target group and other road users, also taking potential collisions with the signpost and line-of-sight obstruction into account.

Sustainability

The sustainability of this measure will be under continual pressure as both public bodies and infrastructure providers may wish access to revenues from advertisers seeking to use display space and advertising bodies will be looking for novel ways to market their products/services.

Consequently, there is a risk that the level of distracters will increase over time.

It is therefore important to review continually the frequency of accidents caused by external influences and to consider whether more could be done to address the issue.

One development that may affect this issue is the increasing level of autonomy that may appear in road vehicles over the next 10-20 years. If users can trust vehicles to drive along (some) routes autonomously, it could be considered that since vehicle riders/occupants do not have to attend to the environment to maintain safe control of the vehicle, advertising can be sited more aggressively.

Transferability

This measure will have more of an impact in industrialized regions since advertising and external displays are more common there.

However, as noted by Wallace (2003), there may be a significant distraction caused by outlying displays in otherwise visually uninteresting environment (e.g. single large advertising board alongside a rural highway).

Consequently, this issue and attempts to address distraction must be considered on a case-by-case basis.

Costs and benefits

No specific studies have addressed the costs and benefits of this measure.

Riders' perspective

★★☆☆☆

The riders' associations strongly support this measure, insofar as it focuses on warning riders about specific dangers and known accident black spots (e.g. decreasing radius bend, gravel) and does not create dangerous distractions for riders and other road users.

Priority

According to both expert ratings and statements, this measure is very easy to implement, but there are concerns about achieving the expected effects and potential side-effects in terms of distraction.

Events Promoting Motorcycle Safety

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	★☆☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★☆☆☆☆

Such events are normally organised as an element of PTW safety campaigns. Events may have various characteristics, the common elements are

- gathering a number of riders and
- "riding safety" as the main topic.

There may be discussion, theoretical tutoring, practical exercises or any combination of these.

Example:

In cooperation with various trade journals, the German Road Safety Council (DVR), the police and the accident research institute have launched the "German Safety Tour". The goal of this campaign is to reduce the number of PTW accidents. At ten different locations, ten PTW riders are invited to attend a workshop consisting of theoretical as well as practical training. There is a special focus on issues concerning perception, on the correct behaviour in traffic and on riding in groups.

http://www.german-safety-tour.de/2010/

In its report "Motorcycle Accidents", AIB suggests that with the help of campaigns, motorcyclists should learn that in traffic, there must always be a safety margin to tackle unexpected situations caused by another road user or an unexpected road course. It is also important that motorcyclists riding together do not pressure each other to drive beyond their capabilities. Thrill seeking motorcycle riding should be done on a track. Besides, through campaigns and information, the motorcyclists must learn to interpret the small signal of the other road users. Slow moving, wait-and-see and hesitant driving may indicate the driver is about to change direction. The motorcyclist must consider that the other road users' attention may be focused on something other than the motorcyclist.

AIB (2009). Motorcycle Accidents, p.77

The European Union Road Federation, the Brussels Programme Centre of the International Road Federation suggests that national governments, associations and federations, manufacturers and the European institutions should join efforts to promote the idea of safe PTW use and to conduct campaigns aimed at better training current and future PTW riders.

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.9

Beneficiaries:

Sensitisation for correct behaviour in traffic and practical training are constitutional for reducing PTW accidents.

Figure 79: Poster of the "German Safety Tour"[74]

Clear definition of the problem

Such a definition should be appointed before planning events. Events may target a wide variety of problems.

[74] Source: ADAC, DVR (2010). Motorrad fahren – auf sicherer Straße!, p.21

PTW riders comprise a vulnerable road user group and one of the contributing accident factors is their riding behaviour which is a result of their reduced perception of risk and increased perception of their own riding skills.

Size of the problem

Such events may address any crash-relevant issue.

Scientific Background, Expected impact

Such events might either target skills or motivation of riders to behave safely. They can be tailored with respect to the intended effect. Assuming the participation is voluntary, it is difficult to control participation and there is a certain risk that such events attract riders, who do not really need the information or training provided. It has to be considered that the total number of participants is likely to be very low compared to the total rider population.

There is always a kind of general preventive effect. Advertising for such events will normally also send a message to non-participants, telling them that there is a problem to solve.

It is very difficult measuring the effects of such events. Normally the group of participants is too small to follow them and number of crashes as an evaluation parameter is by far too low to find significant results. It may also be difficult to separate the impact of these events from other (random) impacts.

Elvik et all (2009, p867ff) summarise several studies on campaigning. Most of the campaigns achieve significantly positive results. The only campaign mentioned addressing PTW was on helmet wearing and increased wearing rates by 60% (from 12 to 19%). None of the studies analysed by Elvik dealt with single events.

Implementation

In general, it is very easy to do anything. The most difficult task may be raising funds. However, there are several issues to consider if such events are not intended to be just anything (i.e. promotion to the organiser or funding body).

- A target has to be defined, including a definition of the target group.
- A program has to be set up to successfully address this target.
- The general preventive effect should be considered for advertising.
- Advertising should be tailored to attract the target group.
- Effects should be monitored.

Acceptance

Assuming that participation to such events is voluntary, no particular group is likely to oppose implementation. After all, acceptance is a question of the program offered and the quality of advertising the event(s).

Sustainability

Single agents of road safety are more likely to have fading effects than repeated of continuous interventions. Hence, the effects of such events are likely to fade over time, depending on the quality of information or training provided.

Transferability

Such events can be implemented anywhere, however, as mentioned above successful implementation requires a lot of competence.

Costs and benefits

No specific studies could be found addressing the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it increases awareness of good practices among riders and helps reach riders that would not otherwise receive the information.

Priority

Events promoting motorcycle safety are very easy to implement and receive high acceptance. It may be more difficult to design effective events. In any case, such events have to be tailored according to a pending problem. The idea of organising events may be highly transferable, but transferring a particular event might be impossible.

Educational Brochures

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★★★★
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	★★☆☆☆	Sustainability	☆☆☆☆☆

Educational brochures usually aim at highlighting specific risky situations or providing general advice to riders.

Example:

ACEM chose a cartoon called “Lucky 13” to help motorcycle and scooter riders avoiding the potential risks related to the infrastructure. The cartoon was launched at the European Road Safety Day organized by the European Commission in Paris in October 2008. The objective of this safety campaign was to raise the riders’ awareness about the potential risks coming from the roadway itself. The campaign featured 13 different situations each focusing on a particular risk factor with tips and recommendations to riders.

ACEM (2010). The Motorcycle Industry in Europe - ACEM Report, p.25

The leaflet “Ride Safe – How you can avoid the 5 most common motorcycle accidents” is addressed to PTWs riders and presents information on the most common PTW accidents. According to an in-depth study of motorcycle crashes, the accidents were divided into five types:

- failure to negotiate left hand bend on country roads;
- failure to negotiate right hand bend on country roads;
- collision at junctions;
- collision while overtaking and
- loss of control.

The leaflet presents the origins of risks and provides advice and recommendations how to avoid these types of accidents.

http://www.rospa.com/roadsafety/info/ridesafe.pdf

Beneficiaries:

Educational brochures focus on various topics. In general, their target is to increase the riders’ awareness, resulting in better choices and in an improvement of their own safety.

Figure 80: ACEM's cartoon "Lucky 13"[75]

Clear definition of the problem, Size of the problem

Definition of a problem is the main task of preparing a brochure. Practically, brochures can address any problem of PTW safety. The effect might be rather limited for practical skills that require training or practicing.

Scientific Background, Expected impact

Brochures might either target skills, knowledge or motivation of riders to behave safely. They can be tailored with respect to the intended effect. Assuming that picking or downloading and reading a brochure is voluntary, it is difficult to control the target group and there is a certain risk that brochures attract riders, who do not really need the information provided. Brochures are a very cheap means of providing information, but it is difficult to target a specific group of recipients.

It is very difficult measuring the effects of issuing brochures. Normally the group of readers is difficult to identify and may be too small to follow them. The number of crashes as an evaluation parameter may be by far too low to find significant results. It may also be difficult to separate the impact of issuing a brochure from other (random) impacts.

Frequently, brochures may be one element of a campaign. Elvik et all (2009, p867ff) summarise several studies on campaigning. Most of the campaigns achieve significantly positive results. The only campaign mentioned addressing PTW was on helmet wearing and increased wearing rates by 60% (from 12 to 19%). None of the studies analysed by Elvik dealt with issuing of stand-alone brochures.

Implementation

In general, it is very easy to do anything. The most difficult task may be raising funds. However, there are several issues to consider if a brochure is not intended to be just anything (i.e. promotion to the organiser or funding body).

- A target has to be defined, including a definition of the target group.
- Contents has to be selected and prepared to successfully address this target.
- Contents and layout should be tailored to attract the target group.
- Effects should be monitored.

Acceptance

Assuming that reading a brochure is a voluntary task, no particular group is likely to oppose implementation. After all, acceptance is a question of the contents offered and the quality of distribution.

Sustainability

Single agents of road safety are more likely to have fading effects than repeated of continuous interventions. Hence, the effects of issuing a brochure may be more sustainable, if the brochure invites and motivates the reader to keep it and read it again. Sustainability of issuing brochures will always be limited to the sustainability of the behaviours or measures the brochure is promoting.

[75] Source: http://pictures.topspeed.com/IMG/crop/200810/european-motorcycle-_460x0w.jpg, 17 Aug. 2010

Transferability

Brochures can be issued anywhere, however, as mentioned above successful implementation requires a lot of competence.

Costs and benefits

No specific studies could be found addressing the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it increases awareness of good practices among riders and helps reach riders that would not otherwise receive the information.

Priority

Issuing brochures is very easy, relatively cheap, but experts seem having concerns about sustainability of effects.

Shocking Films concerning Motorcycle Safety

Expert Assessment			
Overall		★☆☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★☆☆☆☆	Implementation	★★★☆☆
Safety impact	★☆☆☆☆	Acceptance	★☆☆☆☆
Efficiency	☆☆☆☆☆	Sustainability	☆☆☆☆☆

For educational purposes, a key feature is a powerful, graphic TV advertising showing the effects of common motorcycle mistakes e.g. speeding, ostentation or inappropriate clothing. Such a TV spot should cause emotional consternation and make the viewer reflect his/her own behaviour. Shocking films concerning motorcycle safety try to sensitize the target audience to various topics related to PTW riders and their safety e.g. helmet use/ protective equipment in general, traffic behaviour. This measure does not address one specific problem, but tries to convey a message and to raise awareness.

Example:

In Victoria, Australia, the Transport Accident Commission (TAC) launched a motorcycle safety campaign promoting the importance of protective clothing for all riders in March 2008. The public education campaign asked riders "What's between you and the operating theatre?". This campaign, including amongst others shocking films, was developed to highlight the risks associated with riding without the appropriate protective clothing and focused on two key rider groups: Motorcyclists and scooter riders. To complement this existing campaign, TAC broadcasted another shocking film to make riders aware of their extreme vulnerability on the road. The new campaign reminded riders about the types of risks they are exposed to every time they ride and that no matter who is at fault, it likely to come of second best in the case of a crash.

http://www.tacsafety.com.au/jsp/content/NavigationController.do?areaID=13&tierID=2&navID=6F2BE05C7F00000100498EF248E878CB&navLink=null&pageID=1899

Beneficiaries:

Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

Figure 81: Shocking film used for the Victorian motorcycle safety campaign[76]

Clear definition of the problem

The problem cannot be clearly defined as this measure can be used to tackle various different issues. In general, the measure tries to raise awareness and is addressed to PTW riders or to other road users.

Size of the problem

It depends on the problem a shocking film tries to address.

Scientific Background

Best practice guidelines for road safety advertising have been developed within the EC-funded project CAST (Campaigns and Awareness-raising Strategies in Traffic Safety). In a nutshell, shocking contents alone would be more likely to elicit a suppressing effect to the message. Shocking contents should be followed by a phase in which the observer's mind is put at ease.

http://www.cast-eu.org/

Expected impact

CAST's Deliverable D1.3 provides comprehensive information about effectiveness of campaigns. Depending on the subject, collateral measures and quality, the impact of campaigning can be very beneficial; however, inappropriate campaigning can even have a negative impact.

Implementation

Especially the costs are a significant barrier concerning the implementation of this measure. On the one hand, recording, cutting and broadcasting a film is quite expensive. On the other hand, the target audience (given by PTW riders) represents just a small proportion of all road users. Hence, for governmental institutions it is more efficient to develop a shocking film for all road users or just for a larger group, e.g. passenger car drivers, than for PTW riders.

A shocking film alone will hardly have an influence on the PTW riders' behaviour. It should be included in an awareness campaign, which must reach a threshold value in intensity and in duration to be effective. The whole campaign must convey just one clear message in a serious or even shocking way.

CAST guidelines should be considered. CAST also provides comprehensive information about monitoring and evaluating the impact of a campaign.

Acceptance

For campaigns, there is less a question of acceptance, i.e. acceptance can be measured by the practical impact on safety.

Sustainability

Making campaigns sustainable would mean to change road users' attitudes effectively.

[76] Source: http://www.tacsafety.com.au/jsp/content/NavigationController.do?areaID=13&tierID=1&navID=B4347615&navLink= null&pageID=206, 03 Aug. 2010

Transferability

Campaign need to be tailored to pick the target group up where it stands. Hence, a single campaign will be difficult to apply in other places without adaption. However, shocking videos might be an element of a road safety campaign almost everywhere.

Costs and benefits

There were several studies carried out on costs and benefits of campaigns (Elvik et al, 2009, Vaa & Phillips, 2009)

Riders' perspective

☆☆☆☆☆

The riders' associations oppose this measure, because it has been proved that the efficiency of shocking road safety films drops sharply past the point where viewers feel criminalized and reject the message. Funds would be better employed supporting communication campaigns focused on good practices and rider training.

Priorities

The use of shocking videos receives poor appreciation by experts. It seems difficult to get through to the target group, if only PTW riders are addressed. There is a certain risk of achieving negative impact, i.e. suppression to the problem instead of awareness raising. Production and dissemination of videos is rather expensive and may be - considering the small target group - relatively inefficient.

Using Community Collaboration to Promote Motorcycle Safety

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★☆☆☆	Acceptance	★★★★☆
Efficiency	★★★★☆	Sustainability	★☆☆☆☆

This measure involves the organization of events, workshops or campaigns targeting at the improvement of PTW road safety. This organization will be done with the collaboration of several motorcycling bodies/clubs.

If traditional and non-traditional motorcycle community based organizations collaborate, they can promote motorcycle safety by organizing a common event.

Examples:

Taming the Road Safety Rally is a model of collaboration between traditional and non-traditional community based organizations to provide a family oriented rally event to promote motorcycle safety. The primary goal is to promote safe riding including sober riding and safe road habits in a format that invites large groups of riders and non-riders to attend. The format is a one day event (rally) at a motorcycle dealer.

http://www.msf-usa.org/imsc/proceedings/a-Lambert-CycleSafeTamingTheRoadSafetyRally.pdf

In the "Guide for Addressing Collisions Involving Motorcycles" published by TRB, it is mentioned that an important step of any program to improve motorcycle safety is to build strategic alliances between highway agencies, law enforcement agencies, and the motorcycle rider, safety, and education communities. The motorcycle safety community is eager to be a part of the solution because they know that any improvement in motorcycle safety can have a direct effect on them (i.e., it may save their life or the life of a friend). It is recommended that the members of a strategic alliance represent a cross-section of the motorcycling community in the state or region, and that the motorcycle safety issues of that particular state or region be addressed.

TRB (2008). Volume 22: A Guide for Addressing Collisions Involving Motorcycles, p.V-93

In Gloucestershire, the country's Motorcycle Safety Coordinator works together with the mayor local employers. He supports the employees who use motorcycles to travel to work by creating Travel Plans for them.

IHIE (2005). IHIE Guidelines for motorcycling – improving safety through engineering and integration, pp. 61-62

Beneficiaries:

Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

Clear definition of the problem

Such cooperation aims at promoting safe behaviour by riders in general. There may be specific topics. However, the distinctive feature of this measure is not within the topic, it is within the approach.

Size of the problem, Scientific Background, Expected impact

The improvement of rider risk anticipation and perception, as well as the improvement of their skills together with a reduction of their ability perception could result to a potential reduction of PTW accidents and PTW accident severity.

Community collaboration may be considered a holistic approach in order to achieve sustainable effects by using a combination of channels to get the message through. Hence, this measure may be particularly useful for messages which are difficult to communicate by other channels.

Implementation

There are no specific barriers for implementing this measure. It just involves the achievement of good collaboration between organizers.

Critical issues involve the actual context, content and way of demonstrating it to the participant. Another critical issue is that participants who are not members of the motorcycling clubs should also be attracted.

The context of the events should not be such that motorcyclists are presented as victims and other road users as "perpetrators".

Acceptance

Community collaboration may be something that happens mainly behind the scenes. The examples show that there is acceptance among stakeholders, if someone takes the initiative.

Sustainability

The measure is particularly developed to achieve sustainable effects by acting continuously and addressing riders' attitudes.

Transferability

The measure has already been implemented in several countries and hence can be implemented in all European countries.

Whether the results of the measure will differ between countries depends on actual event contents and of whether the event targets problems of the addressed riding population taking into account their mentality. In addition, the mentality of the riding population as this is represented through riding behaviour in each country is also a variable of the measure's effectiveness.

Costs and benefits

No specific studies could be found addressing the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it increases awareness of good practices among riders and helps reach riders that would not otherwise receive the information.

Priority

The assessment of this measure created contradictory results. Although achieving sustainable effects is one of the main goals of this measure, the expert rating in this category is rather low. Although implementation might be rather difficult due to pending conflicts among the potential partners, "implementation" receives five stars. Although such cooperation can address almost any safety problem, the "Size of the Problem" receives only one star. Nevertheless it seems quite clear that cooperation is efficient.

Using Peer Activities to Promote Motorcycle Safety

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★★☆	Sustainability	★★★☆☆

The "safety dialogue" amongst motorcyclists is an important, often overlooked instrument for passing on vital safety information and forming positive attitudes towards safety: Experienced riders share their knowledge of riding techniques, traffic strategies and machine maintenance with novice riders, thus assisting in the prevention of accidents caused by ignorance.

Example:

Experienced riders bring novice riders "back to reality" when exaggerated self-confidence makes their riding dangerous. When motorcyclists meet at a clubhouse or a local roadside cafe, or ride together in groups, safety issues are often the subject of debate. Therefore, the "safety dialogue" among motorcyclists should be encouraged and developed. In order to do so, pan-European educational programmes providing accurate and precise information on key subjects should be prepared. Thereby, information distributed through articles in motorcycle magazines are an important part of the "safety dialogue".

FEMA (2007) A European Agenda for Motorcycle Safety, p.59

Beneficiaries:

Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

Clear definition of the problem

Research findings are difficult to be communicated to the everyday rider. Sometimes the link between riders and scientific findings' dissemination "breaks" down; hence the limitation of diffusion to scientific community member leaves riding clubs out of the equation.

Size of the problem

The size is yet not definable on peer-to-peer communication level.

Scientific Background

Becker and colleagues (2003) conducted a focus group study to identify effective prevention and intervention approaches with 20 motorcycle focus groups-16 Rider Groups and 4 Leadership Groups-in five cities or regions across the United States. The findings of these groups indicate that riders often discourage their peers from riding after drinking, but a culturally reinforced respect for rider freedom and individual responsibility set boundaries for peer actions; (2) rider concern for the safety and security of the motorcycle nearly always overshadows concern for individual safety and contributes to drinking and riding; and (3) motorcycle impoundment and court-ordered payment of costs for vehicle storage, alcohol treatment programmes, and other costs are considered persuasive countermeasures. The results suggest that future drinking-and-riding prevention efforts should incorporate peer approaches and social norms modelling. Crisis Intervention Techniques may be valuable in preventing already impaired riders from operating their motorcycles. Although, this study focuses only on an aspect of motorcycle safety (i.e. drinking) it highlighted the importance of this approach for future implementation.

Implementation

Riders share more similar characteristics than drivers do. They tend to form groups and clubs sharing similar attitudes and attributes regarding riding and safety. Motorcycle safety is promoted by various means. Policies, legislative, and enforcement bodies are one end of line. On the other hand, safe riding behaviour-as all behaviours- is sustainably changed by training and education. In addition, mimic behaviours and patterns when reinforced could lead to healthy behaviours. Therefore, This could be accomplished in two ways: (1) develop or modify existing peer intervention curricula or training and (2) offer training seminars to leaders of nationally recognized motorcycle organizations in a cost-effective, train-the-trainer format, and disseminate this training to local motorcycle clubs.

Expected Impact(s)

The main impact area to be affected is safety. Other impact areas could have effect but subsidiary, therefore not accounted in this measure.

It is difficult to estimate the potential impact of peer activities as the effect largely relies on human activities and responses. It is anticipated to decrease accidents and increase injury mitigation. The successful effect of peer activities measure could be yielded by the conduction of in depth interviews and focus groups of the leaders of motorcycle clubs about the implementation of related activities and of members of these clubs regarding how they incorporated these activities in their everyday riding experience.

Acceptance

Peer activities are expected to be accepted by all types of road users as motorcycle safety is crucial for all road users but also because usually the medium is entertaining and participants (i.e. peers) do not have to spend money or compromise by any other means expect their likelihood to increase their safety. Industry and infrastructure providers are not directly linked to these types of activities. However, industrial activities -like sponsoring events among peer motorcyclists (e.g. regional motorcycle club) - could be beneficial also for a company. Legislative bodies and policy makers could benefit from peer reactions and feedback for motorcycle safety issues in order to take them into account for harmonizing activities and related plans for implementation.

Sustainability

The likelihood of fading of effects is considerably high as riders could change memberships between motorcycle clubs, and subsequently, the information and distribution of knowledge could lose its effect as the reciprocality is lost. Therefore, set standards for peer activities could lead to transferability of messages and thus its sustainability.

Transferability

Set standards for peer activities could lead to transferability of messages and thus its sustainability (i.e. direct link to previous section).

Costs and benefits

Related costs are not high and are not linked to automobile industries or other governmental bodies. The benefits do surpass the costs for this measure. Riders will learn each other how to be safer leading to higher penetration to riders' behavioural patterns of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it increases awareness of good practices among riders and helps reach riders that would not otherwise receive the information.

Priorities

No explanation can be provided why - according to expert ratings - this measure is easy to implement (five stars) but difficult to transfer (no stars). It is clear that a respective network of organisers and peer tutors has to be set up locally, wherever the measure is implemented.

Integrated Road Safety Education Programme

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★☆☆
Total impact	★★★★★	Implementation	★★★★☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★☆

Proper Training and healthy attitudes towards correct behaviour in traffic are important. Attitudes are formed at an early time in life and therefore children should be taught about traffic from kindergarten on, because learning to cope with traffic is a life-long task. Using an integrated long-term approach of teaching safe behaviour is getting the problem at the root.

Examples:

The organization Trygg Trafikk (The Norwegian Council for Road Safety) has stated a programme called “Traffic – Competence – Motivation” for children and adolescents. The different campaigns were adjusted to the age groups of children and adolescents. In kindergarten, they use songs and stories, for traffic education at the primary level the pupils received a booklet which deals with the route to school. There are also programmes, competitions and projects for adolescents such as photo contests or driving days.

In September 2003 the European Commission tendered a project to investigate the situation of Road Safety Education (RSE) in all 25 Member States. It is evident that the differing development paths of school systems, and the differences in traffic, mentalities, cultures and administrations have all led to a fascinating variety of RSE initiatives. With this project the European Commission emphasises the need to collect and exchange good practice in order to launch a discussion on RSE Guidelines at the European level. This effort to strengthen European RSE networks, as well as to create synergies in RSE research and development, is an important investment for the benefit of the young generation. The results of ROSE25 (Inventory And Compiling Of A European Good Practice Guide On Road Safety Education Targeted At Young People) are summarised in a handbook, which includes information on 27 school curricula, 114 media and 193 other activities. The ROSE25 Handbook also provides Best Practice Guidelines on how to design for traffic education also addressing moped riders.

http://ec.europa.eu/transport/rose25/index_en.htm

The objective of the SUPREME (Summary And Publication Of Best Practices In Road Safety In The Member States) project is to collect, analyse, summarise and publish best practices in road safety in the Member States of the European Union as well as in Switzerland and Norway. The SUPREME approach was less comprehensive than ROSE25 in terms of traffic education, since SUPREME also addresses eight other areas of road safety. Nevertheless, SUPREME collected a total of 39 measures of traffic education and assessed them using 8 particular criteria. The Educative Continuum implemented by the Ministère des Transports - Directorat Sécurité Routière in France was identified Best Practice.

http://ec.europa.eu/transport/road_safety/pdf/projects/supreme.pdf

Beneficiaries:

Implementing an Integrated Road Safety Education Programme goes far beyond just creating safe riders, it aims at creating "safe citizens".

Clear definition of the problem

Building behaviour and developing competences is a life-long activity. By common sense, it is easier to learn correct behaviour instead of correcting wrong behaviour. Positive attitudes towards safe behaviour cannot be learned from reading them once in a newspaper; they are an issue of bringing up the children. A continuous process of teaching safe behaviour is most likely to achieve the intended result, since such a long-term process is most likely to effective on the upper levels of the GADGET matrix.

Size of the problem, Scientific Background

A number of studies have researched the impact of traffic education in school by analysing involvement of school children in accidents. These studies showed very positive results within this age group (Elvik et al, 2009, p865). However, it may be assumed that the impact of educational measures go far beyond just influencing children's road accident involvement. Taking in safe behaviour and safety attitudes as a child is likely to create an effect that remains for the whole life of an individual.

Implementation

Implementing integrated road safety education is not an easy task. It requires comprehensive planning and capacity building.

Expected Impact(s)

As already mentioned above, integrated road safety education goes far beyond just creating safe riders. Impacts can be expected even beyond safety.

Acceptance

No objections can be expected, however, it should be considered to involve school teachers' Unions at an early stage.

Sustainability

It may be assumed that Integrated Road Safety Education is the most sustainable among all measures mentioned within this document.

Transferability

The measure can be implemented in any country.

As the society’s mentality is different in different countries, the measure is expected to be less successful in more “loose” societies/countries.

Costs and benefits

There is no data available. It has to be considered that it is impossible to measure the effects of school education, since impacts will be generated years or even decades later, effects cannot be controlled for other impacts. At the same time effects go far beyond just producing safe riders.

Riders’ perspective

★★★★☆

The riders' associations support this measure because training is the best way to increase the safety of young PTW users and future car drivers.

Priorities

According to all available information, this measure should receive top priority.

Peer Activities to Prevent Drink Riding

Expert Assessment			
Overall		★★★★☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★☆☆☆

Findings of the Pacific Institute for Research and Evaluation say that future drinking-and-riding prevention efforts should incorporate peer approaches because of the strong social fabric of motorcyclists.

Example:

The Pacific Institute for Research and Evaluation (PIRE) conducted a focus group study for the National Highway Traffic Safety Administration (NHTSA) to identify potentially successful approaches to prevent drinking and riding. Under this project, a motorcycle safety training program called "Riders Helping Riders" has been developed and pilot tested. The program is based on the findings that riders tend to view themselves as a community of people that looks out for each other but that for various reasons, riders are hesitant to intervene in the drinking and riding behaviour of the peers. The program intends to communicate to riders:

- the extent of the drinking and riding problem,
- the need for riders intervene in the drinking and riding behaviour of their peers,
- "tools" that riders can use to help prevent the drinking and riding of their peers.

McKnight A, Becker L. (2006) Riders Helping Riders: An Alcohol Peer Intervention Program for Motorcyclists

Beneficiaries

Awareness-raising by peers can have a strong effect on the drinking behaviour of motorcyclists. Drunk riders are more likely to be involved in single vehicle crashes because of losing control, running of the road or being inattentive before crashing. These crashes could be reduced.

Figure 82: Campaign concerning PTW accidents due to alcohol consumption[77]

Clear definition of the problem

The problem of drink riding relates to when a motorcyclist operates a motorcycle when their blood alcohol content is above the legal limit set by statute, which is approximately the level at which a person cannot ride safely. However, this level varies across Europe.

Alcohol has detrimental effects on a person's physical performance and cognitive processes, including causing longer reaction times and reduced attention spans, which directly limits one's ability to ride a motorcycle safely.

Alcohol can also act as inhibitor and lead to a person becoming over-confident or more daring, which can often equate to taking more risks. Similarly it affects ones judgment, again this can lead to poor decision making with respect to safe actions.

[77] Source: http://image.motorcyclistonline.com/f/8887975+w750+st0/drunk-ld-lg.jpg, 13 Aug. 2009

Size of the problem

Comparing different road users' accident rates by kilometer travelled highlights that motorcyclists are at a much greater risk of serious injury, for example in Great Britain, the relative risk of being killed or seriously injured whilst riding a motorcycle (KSI) per kilometer travelled is more than 50 times that for car drivers. This is principally because of motorcyclists' vulnerability to injury when collisions occur, for example if a motorcyclists and a car collided the rider would be far more likely to be injured than the driver.

Alcohol is known to have detrimental effects on a rider's ability and therefore will increase their chances of being involved in an accident.

In Great Britain in 2009, half of the riders who were involved in an injury accident were tested for alcohol (breath test) and 2.6% of the tested failed (GB limit is 80mg/100ml). This compares to car drivers, where 55% of those involved in an accident were tested for alcohol (breath test) and 3.7% of the tested failed (RCGB 2009).

Scientific Background

There is a relative dearth of research papers that have specifically studied 'Peer Activities to Prevent Drink Riding'. This is not the case for drunk driving, although caution should be taken before solutions for car drivers are applied to motorcycle riders, where the effectiveness of the countermeasure may be different for different road users.

Becker et al. (2003) (NHTSA Report No. DOT HS 809 490) studied 'Drinking, Riding and Prevention: A Focus Group Study' and sought to identify effective prevention and intervention approaches, by holding 20 motorcycle focus groups, 16 Rider Groups and 4 Leadership Groups. These were held in five cities or regions across the United States. The findings of these groups indicate:

- riders often discourage their peers from riding after drinking, but a culturally reinforced respect for rider freedom and individual responsibility set boundaries for peer actions;
- rider concern for the safety and security of the motorcycle nearly always overshadows concern for individual safety and contributes to drinking and riding; and
- motorcycle impoundment and court-ordered payment of costs for vehicle storage, alcohol treatment programs, and other costs are considered persuasive countermeasures. The results suggest that future drinking-and-riding prevention efforts should incorporate peer approaches and social norms modelling. Crisis Intervention Techniques may be valuable in preventing already impaired riders from operating their motorcycles.

Christmas et al. (2009) undertook a study to provide a better understanding of the needs, motivations and perspectives of motorcyclists with respect to road safety. The project comprised both qualitative and quantitative components. The qualitative phase was designed to yield an understanding of the motivations behind the decisions that have an impact on riders' safety. The insights gained in this phase were then used to design and interpret a quantitative study, using structured questionnaires, which helped give definition to the various user and attitudinal groups. Riders were allocated into a seven segment solution, where the different segments' demographics, attitudes and perceptions of risk were highlighted. A conceptual model was developed for the seven segments and the riders' passion for motorcycling and their relationship to performance were measured. This process was used to describe and quantify their riding behaviour. Key descriptions for two of the segments were:

These are older, summer-only riders who enjoy the social interaction with other riders almost as much as the riding itself – and who like to look the part.

These are passionate riders for whom riding is a way of life, built on a strong relationship with the bike itself and membership of the wider fraternity of riders.

Therefore although Christmas et al. (2009) did not look specifically at the issue of drink riding, the concept and the importance of being part of a 'motorcycling community' or club was identified for a proportion of riders in this study. This starts to indicate that peer based intervention approaches have some potential for some riders.

Implementation

The costs and timescales of such programmes would need to be understood and to be well defined to ensure a successful implementation. These costs are probably the major barrier. Also, evaluation would be essential to measure whether the programme was effective, this all adds to the cost.

Critical issues to be considered when implementing such a measure would be the characteristics of the riders. Europe has a diverse range of motorcycle populations with respect to the types of bikes used, the nature of the journeys, the roads and environmental conditions and the underlying social trends with regards to alcohol consumption and motor vehicle use. These would need to be considered before implementing any programme.

Developing a flexible rider friendly programme that can be genuinely adopted with no unintended consequences – it is very unlikely that a one-size to fit all solution would be pragmatic.

Awareness of such measures could be raised by a number of routes, through media, word of mouth and by well designed viral communication techniques.

Expected Impact(s)

This area has an impact on safety for motorcyclists and other road users.

It would be naïve to believe that it will be possible to prevent all drink riding through one intervention. However, there is an opportunity to explore further what safety benefits could be realized as a result of this approach. The likely impact of the measure would be a reduction in the number of killed and injured on the roads of Europe, but there is very little data available to base an estimate on the target populations per member state.

The in-depth accidents studies undertaken by 2BESAFE provide some indication on the relative importance of alcohol as a contributory or causative factor to accidents, but the representatively of these findings across Europe would need to be considered. Further, not all motorcyclists would be positively affected by a peer based intervention, because some prefer solitary riding as they enjoy the individual experiences and sensations.

Acceptance

Acceptance is likely to high for all stakeholders, especially if the programmes can be shown to be cost effective. The potential exception is the motorcyclists themselves, who may not necessarily welcome the intervention for a number of reasons. Examples could include, ‘it doesn’t apply to me’, ‘I ride alone and don’t have peers to influence or be influenced by’ or ‘I ride safely it is the other road users/ infrastructure etc that needs to change’.

There is a danger that there could be a relatively small group of ‘hard core’ drinkers and riders who would not be open to this sort of programme; these could be lone riders or groups of social riders.

Different motivational approaches should be considered, for example highlighting the personal injury consequences to you or others that may occur through drink riding might resonate for some; whilst the personal consequences associated with losing your license and motorcycle because of drinking may prove more powerful thought provoking messages for others.

There are a number of riders for whom such consequences would not be considered as sufficiently serious or perceived to be likely to occur to them and here is the real challenge.

Sustainability

There is always a risk of fading effects from any behavioural change or awareness programme, but there is good evidence that drink driving in some European states has become far less sociably acceptable and therefore less common over recent years. Therefore, with a constant refreshing of the message it is reasonable to assume that this trend could be observed more widely across Europe for motorcyclists.

Transferability

Implementations of such measures are clearly possible across Europe. However, I would not expect the intervention to have the same impact in different countries.

Costs and benefits

No specific studies have addressed the costs and benefits of this measure in terms of PTW riders.

Riders' perspective

★★★★☆

The riders' associations support this measure, because it increases awareness of good practices among riders and helps reach riders that would not otherwise receive the information.

Priority

The relative percentage of alcohol related collisions is lower than those caused by other issues, perhaps most notably speed. Experts consider this measure very effective and efficient, but difficult to transfer. Experts also seem to have concerns about sustainability of effects.

Programmes to Increase Awareness on Safety Helmet Use

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★☆☆

The collaboration of various bodies, e.g. political leaders, local authorities and agencies, NGOs, private sector or community leaders shall increase awareness on proper safety helmet use especially in rural areas. Various coordinated activities, such as talks, seminars and advocacy actions shall draw the attention and interest of the targeted group of people.

Example:

In Italy, the national law concerning the helmet use was adopted in March 2000. This law ratifies, as compulsory, the use of an approved helmet for all motorbike, motorcycle and mopeds drivers, and their passengers, independent of their age. The law represents a change from an earlier July 1986 law, which required the use of helmets for all individuals only for motorcycle drivers whereas moped drivers had to wear a helmet only when less than 18 years of age. The adoption of this law was accompanied by a comprehensive media and enforcement campaign. The combination of both – police enforcement and an effective education campaign – appears to have resulted in a significant increase in helmet wearing and a measurable reduction in PTW rider head injuries.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1731012/pdf/v009p00257.pdf

ACEM's "Wear & Lock" campaign was launched during the Road Safety Week in April 2007. It targeted young riders and it involved three National Associations (Anesdor, Ancma and Rai) as well as national, regional and local authorities, police forces, schools and dealership organizations. The whole campaign built on the four pillars of prevention, enforcement, education and icon-branding. It involved the use of television broadcast, information leaflets and billboards. Schools participated in the campaign with dedicated classroom education and with the dissemination of information material. National, regional and local authorities and police forces, as contributing partners, have been performing dedicated helmet wearing monitoring and enforcement.

The key messages that were conveyed to the PTW riders were:

- Always wear a helmet
- Always lock the helmet's chinstrap
- Always choose ECE type approved helmets
- Always use a proper size helmet
- Never take a passenger without a helmet.

ACEM (2008). A Safety Plan for Action, p.11

The fourth strategy in the Malaysian Road Safety Education Plan is the Community Based Programme on Safety Helmet. It is a ‘Programme by the People for the People’. The Road Safety Department functions as the main body spearheading the programme and collaborating with various local bodies in concerted action to increase awareness on safety helmet use. Through this programme, helmets were distributed on a complimentary basis to villagers to encourage the proper use of safety helmets. The campaign included various activities such as safety talks for the public, counselling and advisory services and also enforcement by Road Transport Department and the Royal Malaysian Police Force. An evaluation showed that the percentage of helmet use increased ten weeks after the campaign launch in all participating districts.

http://www.panducermat.org.my/event_gallery_portdickson_eng.html

Beneficiaries:

The measure is beneficial for PTW Riders as helmets improve the rider’s safety. Sensitisation for correct behaviour in traffic is a sustainable way for reducing road accidents.

Figure 83: ACEM’s “Wear & Lock” campaign[78]

Clear definition of the problem

Injuries to the head and neck are the main cause of death, severe injury and disability among users of motorcycles and bicycles. In European countries, head injuries contribute to around 75% of deaths among motorized two-wheeler users; in some low-income and middle-income countries head injuries are estimated to account for up to 88% of such fatalities (Motorcycle safety helmets. COST 327, 2001).

Size of the problem

Riders are vulnerable road users by definition. The most vulnerable part of their body is their head and the most dangerous part of the body if injury occurs. Motorcyclists who do not wear helmets are at a much higher risk of sustaining head injuries and from dying from these injuries.

Scientific Background

There have been many studies that have evaluated the impact of motorcycle helmet laws on helmet-wearing rates, head injury or death. When mandatory helmet laws are enforced, helmet-wearing rates have been found to increase to 90% or higher (Kraus et al., 1995; Servadei et al., 2003) when such laws are repealed, wearing rates fall back to generally less than 60% (Turner et al., 2004; Preusser et al., 2000).

Implementation

The only potential barrier for the implementation may be the constraints at national level. For example, it is more difficult to keep the helmet on in south European countries during summer time although rider awareness might be high. As aforementioned, awareness programmes should take into account national, regional constraints and idiosyncrasies in order to not be effective only on general level. For the implementation of awareness programmes scientific jargon should be avoided and focus of awareness should be clear before the design of the programme itself. Increased awareness is plausible by the maximization of implementation of both the measure and its publicity through other dissemination media.

[78] Source: http://www.acem.eu/media/d_SafetyPlanforAction_94993.pdf, 23 Jun. 2010

Expected Impact(s)

Awareness impact is primarily on safety and, specifically, rider's protection and safety. Increase awareness does not necessarily translate to decreased injuries and fatalities. However, it is anticipated to increase helmet use by 10-15%. This measure would be successful if it results in an increase of 15% of helmet use. Increased awareness might escalate around the period of time the programme is running but to fade after it ends. The expected impact of this measure in addressing the problem would be 4.

Acceptance

Increased awareness programmes will be well received by governmental and education related bodies. These programmes are a reliable index of strengthening stakeholder groups related to PTWs before and after motorcycles reach their end users. Therefore, expected acceptance is moderate to high with emphasis to education and training providers.

Sustainability

There is a high risk of fading for raising awareness programmes because usually their effect is not permanent. Riders might forget the information they receive and lose the potential link between the importance of the information and its practical effect in their everyday riding experience. In addition, a potential ceiling awareness effect could lead to receiving already known information.

Practically, the information received by the awareness programme should be paired with real training schemes that could enhance its behavioural effects. In addition, continuous enrichment of the awareness programmes could provide new and useful information that could add upon the existing one. The latter allows for the old awareness levels to be preserved but also to increase as new information is obtained.

Transferability

Transferability of measure is attainable up to a general knowledge and basics (e.g. injuries, accidents, etc.); however, finding the way to "connect" with users should be adopted to both the awareness level of the specific country but also to cultural and idiosyncratic characteristics of the country and, hence, their riders.

Costs and benefits

Elvik et al (2009) declare campaigns not to be cost-efficient if not linked with respective enforcement activities.

Riders' perspective

★★★★☆

The riders' associations support this measure for use in areas where low compliance with helmet laws have been observed, and in conjunction with campaigns and awareness programmes on good practices for riders.

Priorities

Increasing awareness for helmet use should be of high priority but has to be linked with respective enforcement activities.

Promotion of Protective Equipment

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★★★

Constant exposure to the elements is physically dangerous, but wind, weather conditions, and temperature extremes can also affect a rider's concentration. Furthermore, dehydration, overheating, and hypothermia can compromise a rider's judgment and cause decreased vision, light-headedness, and impaired coordination. Safety is the main reason to wear protective apparel, but comfort is important also.

The objective of this kind of promotion strategy is to convince riders to wear clothing that provides protection and comfort from the elements as well as from the dangers of a fall from the motorcycle. Wearing protective clothing can make the difference between an uncomfortable slide and severe injury along with months of rehabilitation. Therefore, public information and education resources for motorcyclists to understand the benefits of helmets and protective gear should be developed.

Example:

While much is being done on aspects such as vehicle safety features, training and awareness raising, improvements in road safety can be achieved also by promoting protective motorcycling wear adapted to the type and the use of vehicle. Because of this, ACEM has released a booklet in seven languages with indications on which equipment to choose (jackets, trousers, boots, gloves, helmets, visors, goggles, ear plugs and body protectors). This brochure has been developed within the eSUM Project ensuing from the cooperation between ACEM and four European motorcycling capitals (London, Paris, Barcelona and Rome). The publication of the Personal Protective Equipment guide is part of ACEM's commitment to road safety, which follows an integrated approach looking at human factors, vehicle design and infrastructure, seeking to involve policymakers at European, National and local level and other relevant stakeholders.

http://www.acem.eu/cms/ppe.php

According to AIB, motorcyclists must be informed through campaigns of the correct clothing. A strong luminescent color on a high visibility vest or motorcycle jacket can prevent accidents. Helmets, boots and durable clothes can reduce injuries. It is important that helmets also protect the lower face, is properly secured and fits the head. Regardless of the trip's length, the correct clothing must be worn – there are no "short trips"!

AIB (2009). Motorcycle Accidents, p.76

Beneficiaries:

Personal Protective Equipment can help motorcycle, scooter and moped riders to reduce the effects of accidents. Nonetheless the benefits offered by motorcycling garments are still widely underestimated. Hence, the goal of promotion campaigns on protective equipment is to help increasing the number of motorcyclists equipped with appropriate protective clothing. Thus, they are beneficial for all PTW riders and reduce some of the accidents caused by affected concentration or diminish the consequences of a collision.

Figure 84: ACEM's Personal Protective Equipment guide[79]

Clear definition of the problem

Motorcyclists are extremely vulnerable when they experience collisions with other vehicles, objects or the road surface.

Protective equipment generally comprises:

- Helmets
- Gloves
- Boots
- Clothing (abrasion resistance, burst strength, cut resistance)
- Impact protectors
- Back protectors

There are two main ways in which riders are likely to be injured during crashes:

- Impact, typically with the road surface or kerb, roadside objects such as signs, walls and trees, or with other vehicles. The severity of injury sustained may be reduced by impact protectors, which can either cushion or spread direct impact forces. Helmets are essential to absorb the energy of impact and lessen the forces and accelerations that the head experiences. Body protectors are usually placed over joints (elbows, shoulders, knees), the back and occasionally other areas (collar bones, hips, chest).
- Friction based injuries, usually from sliding or rolling along the road surface. These injuries, which may result in the loss of skin, soft tissue, or bone, can be reduced or eliminated by the outer fabric of the rider's clothing. Historically, good quality leather has provided the highest levels of protection, but more recently some man-made fabrics are achieving equivalent and in some cases better abrasion resistance. However, to provide protection the clothing must remain intact, relying on the material's tear resistance, abrasion resistance and seam strength. Additional thicknesses of material may be placed over vulnerable areas.

So in summary, protective equipment can mitigate and/or prevent blunt trauma injuries, especially to the head, and de-gloving injuries caused by the friction effect as the rider or pillion passenger slide along the road surface.

Size of the problem

Comparing different road users' accident rates by kilometer travelled highlights that motorcyclists are at a much greater risk of serious injury, for example in Great Britain, the relative risk of being killed or seriously injured whilst riding a motorcycle (KSI) per kilometer travelled is more than 50 times that for car drivers. This is principally because of motorcyclists' vulnerability to injury when collisions occur, for example if a motorcyclists and a car collided the rider would be far more likely to be injured than the driver.

The size of the injurious problem that protective equipment could address for Europe is not well understood.

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[79] Source: http://www.acem.eu/cms/ppe.php, 08 Sep. 2010

Scientific Background

There is only a limited amount of information on the effectiveness of protective equipment within Europe and this is further complicated because the majority of commercially available motorcycle-specific clothing has not been tested and approved to the available standards. However, that does not mean that an equivalent level of protection is not provided when that clothing is used.

The implications for riders of equipment not displaying such accreditation are in two areas:

- equipment which has not been accredited may not be advertised as giving 'protection'; and
- purchasers will not be aware of the level of protection which their equipment might offer.

An Australian study by de Rome *et al*. found riders were significantly less likely to be admitted to hospital if they crashed wearing motorcycle jackets, pants (trousers) or gloves. Further when garments included fitted body armour there was a significant reduced risk of injury to the upper body, hands and wrists, legs, feet and ankles. Interestingly, non-motorcycle boots were also associated with a reduced risk of injury compared to shoes or joggers (trainers).

The Australian team also reported:

- no association was found between the use of body armour and risk of fracture injuries; and
- a substantial proportion of motorcycle designed gloves (26%), jackets (30%) and trousers (28%) were assessed to have failed due to material damage in the crash.

A wide variety of equipment is available to riders, who must select that appropriate to their specific requirements. Typically, these choices are based on certain criteria:

- The conditions they will be riding in (e.g. adverse weather)
- The machine ridden (e.g. 'race' leathers on a 'sports' motorcycle)
- The riding they will be doing (e.g. commuters wearing weather-proof 'motorcycle' clothing over 'office' clothing)

The MAIDS project reported extensively on protective equipment and concluded that significant safety benefits could be realized if it was worn by all motorcyclists.

Christmas *et al.* (2009) investigated riders' motivations and risk perception, and self reported decisions with respect to choice of bike, helmet, safety gear. The team reported that the real challenge in promoting safer helmets and gear is not to sell the importance of safety, but to influence perceptions of what is safe enough. Motorcycle riders comprise a diverse population, where some are extremely safety conscious and have very good understanding of risks and what equipment is required and how to maintain it. Others are perhaps less aware of the importance of protective equipment and indeed some are blasé about it, not believing it is important for them.

In the UK, the Safety Helmet Assessment and Rating Programme (SHARP) (http://sharp.direct.gov.uk/), is designed to help riders make a more informed choice when choosing a helmet based on safety. Such schemes can provide valuable information to consumers, but their popularity and profile vary between different riders.

A wide range of helmets are available, but they fall into three main categories:

- 'Open' face; in the event of a crash, these helmets offer no protection to the rider's face. However, in hot weather there is increase comfort for the wearer. When wearing these helmets, eye protection is usually provided by a supplementary visor or goggles.
- 'Full face'; these helmets have an integrated chin bar and pivoted visor. Although providing superior facial protection – both to injury and adverse weather protection- compared to the 'open' face helmets, since the rider's face is enclosed they can be hot and claustrophobic.
- 'Flip' front; these helmets feature a pivoting front section, usually the chin bar and visor, which can be raised when required (although not usually when riding).

The most important aspect of helmet selection is to ensure that the correct fit, both for comfort (a tight helmet can cause considerable discomfort) and safety (a loose helmet may leave the rider's head during a crash). An essential part of the process of helmet fitting is to ensure that the helmet cannot be removed with the strapped tightened.

Visors, as used on full face and flip front helmets, are typically coated to offer a degree of abrasion resistance. However, this is to resist light wear and scratching which would otherwise reduce the rider's vision, particularly at night where the scratches can cause 'starring' from light sources such as headlamps. Similarly, a range of anti-mist treatments are available to reduce the problem of the visor misting on the inside, usually caused by the rider's exhaled breath.

Some riders who wear open face helmets also use face masks of various types to give additional protection from adverse weather. Also available are face masks which incorporate activated charcoal filters to remove dust etc.

New technologies: For riders requiring additional protection, extra equipment is available, although not CE certified:

- 'Airbag' technology, whether designed as part of the main garment (either in a leather suit or a man-made fabric jacket) or as a waistcoat worn over the rider's main garment.
- Neck brace, originally designed for off-road riders to protect against neck injuries, is available in a 'road' version.

During cold weather, riders may choose to supplement their usual clothing with additional clothing. This can include electrically-heated clothing such as waistcoats and glove liners.

Implementation

The costs and timescales of such programmes would need to be understood and to be well defined to ensure a successful implementation. These costs are probably the major barrier. Also, evaluation would be essential to measure whether the programme was effective, this all adds to the cost.

Critical issues to be considered when implementing such a measure would be the characteristics of the riders. Europe has a diverse range of motorcycle populations with respect to the types of bikes used, the nature of the journeys, the roads and environmental conditions and the underlying social trends with regards to their perceptions of risk and to what degree they believe protective equipment would be effective. These would need to be considered before implementing any programme.

Developing a flexible rider friendly programme that can be genuinely adopted with no unintended consequences – it is very unlikely that a one-size to fit all solution would be pragmatic

Awareness of such measures could be raised by a number of routes, through media, word of mouth by well designed viral communications. Consideration should be given to the compromises riders make when selecting equipment:

- Protection; although the highest levels of impact and abrasion resistance are usually offered by racing leathers, these are impractical for day-to-day riding, especially since they offer little or no protection against adverse weather conditions and will require the rider to change into other clothing when they reach their destination.
- Price; many riders are unable to commit to the cost of much high-end motorcycle clothing – some two piece 'touring' suits are priced at about £1000.
- Style; some riders will demand that their riding equipment is matched to the image portrayed by their motorcycle, others will be influenced by fashion trends.

Expected Impact(s)

This area has an impact on safety for motorcyclists.

The likely impact of the measure would be a reduction in the number of killed and injured on the roads of Europe, but there is very little data available to base an estimate on the target populations per member state.

There is just one legally-required item which must be worn by all motorcyclists: a helmet meeting the appropriate legislation. All other items are used at the rider's discretion; often, items of clothing used by motorcyclists will not be manufactured specifically for motorcycling.

Of items specifically designed for riding, eye protection (whether by goggles, visors or other equipment) is the only item which has a legal requirement to meet the appropriate standard – although there is no requirement for riders to wear any type of eye protection.

Perhaps paradoxically, much of the purpose-designed clothing and equipment available to riders does not qualify as 'protective' since no specific test standards are in place which those items must meet in order to claim that the item provides some form of protection. Therefore, the promotion of protective equipment is further complicated by the definition of what is and what is not protective equipment and this will need to be managed to maximize the expected impact of any promotional scheme.

The in-depth accidents studies undertaken by 2BESAFE may provide some indication on the relative importance of protective equipment to mitigate or prevent injuries, but the representatively of these findings across Europe would need to be considered.

If such programmes were shown to be successful, well designed before and after studies should be implemented to measure their success.

Acceptance

Acceptance is likely to be high for all stakeholders, especially if the programmes can be shown to be cost effective. The potential exception is the motorcyclists themselves, for whom a proportion may not necessarily welcome the intervention for a number of reasons.

Sustainability

There is always a risk of fading effects from any behavioural change or awareness programme. However, with a constant refreshing of the message it is reasonable to assume that protective equipment could be used more widely across Europe by motorcyclists.

Transferability

Implementations of such measures are clearly possible across Europe. However, I would not expect the intervention to have the same impact in different countries.

Costs and benefits

Several studies have been executed on the protective impact of crash helmets. According to Elvik et al (2009, p596ff), there is an excellent ratio (17 +/-6) between benefits and costs. For other protective equipment, the benefits strike out the costs by a factor of about 5.3 (Elvik, 2009, p582ff).

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it increases awareness of good practices among riders.

Priorities

Helmet wearing is obligatory in all EU Member States with a couple of exceptions for particular groups of moped users. However, there are still riders killed who did not wear a helmet when they crashed. There also seems to be a problem of properly closing the chin strap, which is likely to cause ejection of the helmet during a crash. No country has an explicit obligation to wear other protective clothing. Hence, motivation is a key issue; with respect to the huge benefits in terms of crash costs, this promotion of protective equipment should receive top priority.

14. Rehabilitation and Diagnostics

Rehabilitation and diagnostics measures are mainly applied in the German-speaking language area. The listed measures have already been published in the "Summary and Publication of Best Practices in Road Safety" of the SUPREME project. A positive impact of these measures has already been approved. An important question came up if developing explicit motorcycle measures was actually necessary.

Rehabilitation of Severe Violators

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★★☆☆☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★☆☆☆☆
Efficiency	★★★★☆	Sustainability	☆☆☆☆☆

The measure involves a mandatory course for drivers with severe violations, such as drink driving and speeding could be an important part of driver license reinstatement. The course makes participants aware of the relationship between violations and personal attitudes, aiming to elaborate ways to correct both. Knowledge gaps, e.g. about the effects of speed and speeding, are filled and adjusted. Behaviour patterns are developed, tested and rudimentarily stabilized.

Examples:

In Austria, Mandatory Driver Improvement Courses focus on rehabilitation of severe violators. Courses for drink driving offences are separated from those of other offences. Some institutes also distinguish between novice drivers and experienced drivers. Courses are held for 6 to 11 participants and consist of 15 units of 50 minutes each, divided into five sessions. Sessions are separated by an interval of at least two days. The courses are performed by traffic psychological institutes, appointed by the Federal Ministry of Transport. They have to meet special standards defined in the licensing law.

http://www.druid-project.eu/cln_007/nn_107548/Druid/EN/deliverales-list/downloads/Deliverable__5__2__3,templateId=raw,property=publicationFile.pdf/Deliverable_5_2_3.pdf

In Switzerland, training courses for recidivist drunk drivers are held for drivers with two drink driving convictions. Drivers addicted to alcohol are excluded. Participation in the programme is optional, but combined with earlier driver license reinstatement. A preliminary personal interview provides insight in the individual participant. The programme provides information on the topic of alcohol and driving (legal and statistical aspects, as well as physical effects of alcohol). Participants are supported in tackling their own drinking habits and encouraged to define their personal solutions. Homework is an important mean for achieving a change in behaviour. The programme lasts 8 to 12 weeks, consists of 6 group sessions of 2 hours (maximum of 10 participants) and a 1 hour individual discussion. On average, it takes 6 months between the offence and course participation. The courses are conducted by psychologists who generally have additional therapeutic training. They are appointed by the cantonal authorities and trained by the Swiss Council for Accident Prevention (bfu).

http://www.druid-project.eu/cln_007/nn_107548/Druid/EN/deliverales-list/downloads/Deliverable__5__2__3,templateId=raw,property=publicationFile.pdf/Deliverable_5_2_3.pdf

In the UK, when a motorist is involved in a Road Traffic Incident and there is sufficient evidence which indicates that they have been "Driving Without Due Care and Attention, or Driving Without Reasonable Consideration for Other Road Users", or other like offences, they may be given an option to attend a National Driver Improvement Course. This is offered as an alternative to having the incident referred to the Crown Prosecution Service which usually results in a summons to attend court where they may receive a fine and penalty points on their driving license. The courses are 1 1/2 days long and involve a mixture of driving theory, utilizing the latest researched thinking on 'low-risk' driving techniques, combined with modern training methods in practical on-road. Depending on the service provider, the course is delivered by DfT approved driving instructors, who have to fulfill essential minimum tutor qualifications, and road safety officers. All practical training is done by DfT approved driving instructors. After successfully completing the course, the police report on the motorist's file will closed and no further action will be taken with regard to the incident. The date of course completion is recorded. If the motorist is involved an another road traffic incident of a similar type within three years the date of the offence, then the matter will automatically be considered for prosecution as another offer will not be made.

Next to this Course, a pilot alternative called Driver Alertness Course exists. It has been developed by the strategic Course Development Group of National Driver Offender Retraining Scheme (NDORS) as a possible alternative or replacement of the National Driver Improvement Course. It is being piloted and evaluated by a number of police authorities from September 2009. The Driver Alertness course is held over one day and consists of a combination of theory sessions and practical drives. Thereby, the theory part of the course is split into 3 modules and the practical part of the course will involve driving with specially selected and trained approved driving instructors, all of whom have a vast knowledge and understanding of advanced driving techniques and an extensive experience in the field. There is no pass or fail criteria for the course but it is required that a person must attend all of the sessions and demonstrate a willingness to participate.

http://www.driver-improvement.co.uk/index.php/home/driver-improvement-scheme

http://www.driver-improvement.co.uk/index.php/home/driver-alertness-course

Another example is the Devon County Council Rider Risk Reduction Course. It is based on an established model of intervention, which has been tried and tested and used in tackling such problem behaviours as drug addiction and alcoholism. There are eight modules that walk through a step by step process (Facts of life/ Why am I here?/ Human limits/ Hazard perception/ I'm in control/ Bad habits and emotional baggage/ Video scenarios/ Ride safe, keep riding). The whole course is aimed at motorcycle riders who have been stopped by the Police for committing a violation which would normally lead to a fixed penalty notice. Instead, they are given the opportunity to attend this course as an alternative to facing the possibility of prosecution. The primary aim of the intervention is to give such riders a greater sense of their vulnerability and their limitations as a human-being. The attending riders should develop a better attitude towards the risks they are prepared to expose themselves to.

http://www.devon.gov.uk/index/transport/traffic/road_safety/%20biker_safety/rider_training/rider_risk_reduction_course.htm

Beneficiaries:

Alcohol abuse is neither specific to any kind of traffic accident nor to any group of victims. It is both the (potential) offenders as well as all other road users being protected.

Clear definition of the problem

Accident rates dramatically increase at higher blood alcohol level. Several studies give proof for car drivers or all road users, but not study was found particularly addressing PTW.

Size of the problem

Undoubtedly, alcohol abuse is one of the main contributing factors to traffic death and injury (e.g. 25% in Belgium, ETSC, 2011; 30% in Italy, ETSC, 2010).

In Europe, the rate of fatalities attributable to alcohol for motorcyclists is around half of that of car drivers (DfT, UK, 2009).

The in-depth accidents studies undertaken by 2BESAFE provide some indication on the relative importance of alcohol as a contributory or causative factor to accidents, but the representatively of these findings across Europe would need to be considered.

Scientific Background, Expected impact

Within a timeframe of 2.5 years, 30.6% of drink driving offenders who had not participated in a driver improvement course had a relapse, compared to 15.8% of those who had.

http://www.kfv.at/index.php?id=388

Many studies report recidivism rates to be reduced by about 50% for drunk drivers who participated in a rehabilitation programme compared to drunk drivers without such participation over a two to five year observation period.

http://www.bfu.ch/english/researchnews/ergebnisse/report/r_52_e.pdf

Implementation, Transferability

The SUPREME thematic report on Rehabilitation And Diagnostics (Bächli-Bietry, Achermann, Siegrist, 2007) set up Best Practice Guidelines on implementing rehabilitation measures, where legal and technical recommendation can be found. Implementation particularly requires capacity building in terms of qualified moderators.

Acceptance

According to experience from countries, where rehabilitation schemes are already in place, noticeable resistance to this measure only came from wine, hotel and restaurant industry.

This measure will not be accepted if applied only to PTW riders.

Sustainability

There may be some fading in the general preventive effect. For the special preventive effect, no fading can be expected assuming that courses are provided at a constant quality level. To achieve that, quality management systems should be in place. Comprehensive information on

Costs and benefits

No specific studies have addressed the costs and benefits of this measure in terms of PTW riders.

Riders' perspective

★★☆☆☆

(no comment)

Priorities

This kind of measure is not suitable to be particularly implemented addressing PTW riders. In general, rehabilitation courses for alcohol offenders are recommended to be part of any licensing system, but driving under the influence of alcohol is considered a smaller problem to PTW riders than to other groups of road users.

Rehabilitation of Young Offenders

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★★☆	Acceptance	★☆☆☆☆
Efficiency	★★★★☆	Sustainability	★☆☆☆☆

This measure involves offering courses for novice PTW offenders in order to increase risk awareness and improve their riding behaviour in respect to safety. The course could be mandatory or voluntary. The aim of the measure is to avoid repeat offences by offering a course for novice drivers where the risk awareness on the road gets influenced and the riders are motivated to behave more safely and with more regard to others.

Example:

In Germany, this is a measure for novice drivers in their probation period who have committed a traffic law violation. The course is mandatory. The intervention comprises the following elements: self-reflection (self-evaluation), change of behaviour and attitudes and building up new strategies. The intervention also comprises a drive with other participants, which results in peer-to-peer feedback. The course comprises four sessions of 135 minutes each and includes a practical driving observation session between the first and the second session. The training sessions should be taken in a period of minimum 14 days and maximum 4 weeks. The seminar is implemented by special qualified driving school trainers. The programme was developed by DVR and road safety education experts.

http://www.dvr.de/site.aspx?url=html/sonst/148_20.htm

Beneficiaries:

On the one hand, it is the offender who shall be support in getting along with his situation as someone that has been convicted. Avoiding repeated offences if beneficial for the participant as well as for all other road users.

Clear definition of the problem

Rehabilitation courses have a general preventive effect in case they are mandatory under specific circumstances, in this case, for young offenders. Rehabilitation courses also have a special preventive effect for those who participate either voluntary or ordered. On the one hand, these courses are designed to avoid repeated offences by changing participants' attitudes. On the other, participant shall be supported in getting along with their situation of someone who has been caught in the act.

Size of the problem

Novice riders comprise a vulnerable road user group and demonstrate substantially high risk rates. Within the recent years, there has been a significant change in accident records. It is not the case anymore that young riders dominate, nowadays, in most of the European countries, PTW fatalities and injuries are evenly distributed over all age groups.

Scientific Background, Expected impact

A study by Christ, Brandstaetter and Smuc (2000) found a 10% reduction of accident involvement for young license holders after implementation of a driving license system on probation including mandatory rehabilitation courses for young offenders.

Implementation, Transferability

The SUPREME thematic report on Rehabilitation And Diagnostics (Bächli-Bietry, Achermann, Siegrist, 2007) set up Best Practice Guidelines on implementing rehabilitation measures, where legal and technical recommendation can be found. Implementation particularly requires capacity building in terms of qualified moderators.

Acceptance

An opinion poll on the Austrian "Driving License on Probation" model (Bartl et al, 1993) has shown that about 90% of a representative sample as well as 90% of holders of a driving license on probation believe that it is a suitable measure to reduce the accident risk of young novices. About 80% of the interviewees agree both with the driver improvement courses for novice drivers committing traffic violations and with the specific 0.01% BAC limit.

This measure will not be accepted if applied only to PTW riders.

Sustainability

There may be some fading in the general preventive effect. For the special preventive effect, no fading can be expected assuming that courses are provided at a constant quality level. To achieve that, quality management systems should be in place. Comprehensive information on

Costs and benefits

No specific studies have addressed the costs and benefits of this measure in terms of PTW riders.

Riders' perspective

★★★★★

(no comment)

Priorities

This kind of measure is not suitable to be particularly implemented addressing PTW riders. In general, rehabilitation courses for young offenders are recommended to be part of any licensing system.

Traffic-Psychological Assessment of Drink Drivers

Expert Assessment			
Overall		★★☆☆☆	
Size	★☆☆☆☆	Transferability	★★☆☆☆
Total impact	★★☆☆☆	Implementation	★★★☆☆
Safety impact	★★★☆☆	Acceptance	★★☆☆☆
Efficiency	★★★☆☆	Sustainability	★★☆☆☆

The goal of this diagnostic assessment is to make a prognosis of the future drink driving behaviour of drivers whose driving license was revoked because of drunk driving. The traffic psychological assessment consists of a performance test and a personality test, sometimes preceded by a medical investigation. It has to be considered that drunk driving, in particular at high BAC level, in most cases is not the result of a single drinking event but the result of ongoing misuse of alcohol.

Example:

If an Austrian driver is detected driving with an alcohol level of 0.16% BAC or more or if he refuses the breath test (or investigation by a health officer or blood sample), he is required by law to undergo a traffic psychological assessment. The traffic psychological investigation takes about 3 to 4 hours for the client. If the overall assessment is negative, the license remains revoked until sufficient driving capability is attested and/or sufficient willingness to adapt to the traffic rules is restored. By law, the assessment is combined with a license revocation of at least six months, a fine, and participation in a driver improvement course. The assessments are performed by specially trained psychologists (traffic psychologists) in qualified assessment institutes in cooperation with the driving license registration office.

http://www.druid-project.eu/cln_007/nn_107548/Druid/EN/deliverales-list/downloads/Deliverable__5__2__3, templateId=raw,property=publicationFile.pdf/Deliverable_5_2_3.pdf

Beneficiaries:

All road users can be considered as beneficiaries of traffic psychological assessments of drink drivers. With a reliable prediction of driver's risk behaviour, experts can come to a well-considered decision concerning the recovery of driving licenses. The diagnostic tests need to be based on a judgment of the functional impairments relevant for safe driving.

Figure 85: Traffic-psychological assessment[80]

Clear definition and size of the problem

In 2003 in Germany 24554 accidents with bodily injuries were caused by road users under the influence of alcohol (Schubert, 2005). 6% of all fatal road accidents in Austria in 2010 have been alcohol accidents.

http://www.statistik.at/web_de/statistiken/gesundheit/unfaelle/strassenverkehrsunfaelle/019872.html

Alcohol makes people lose their inhibit, it reduces the driving performance and can negatively effect owns sentiment; therefore alcohol negatively influences traffic safety.

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[80] Source: KfV

Traffic psychological assessment of Drink Drivers collects facts about drinking behaviour and the connection of driving specific abilities and driving behaviour. This aims at predicting future behaviour of drink drivers in order to reduce accidents.

Expected Impact(s)

Statistics from Germany show that in 2010 9.7% of all road users that caused accidents under the influence of alcohol have been PTW riders. 346 road users have been killed in alcohol accidents in 2010 in Germany.

Driving or riding under the influence of alcohol can still be considered as a severe problem, although the number of alcohol accidents decreases, e.g. Germany 2000: 27.375 alcohol accidents with bodily injured road users, 2010: 15.109 alcohol accidents with bodily injured road users.

The impact of traffic psychological assessment of drink drivers is considered as crucial.

http://www.dvr.de/download/US_Alkoholunfaelle_2010.pdf

http://www.dvr.de/betriebe_bg/daten/unfallstatistiken143.htm

Acceptance

According to experience from countries, where traffic psychological assessment schemes are already in place, noticeable resistance to this measure only came from wine, hotel and restaurant industry. Motorist associations might object the measure.

This measure will not be accepted if applied only to PTW riders.

Sustainability

The aim of traffic psychological assessment is to prognosticate future behaviour of drink drivers. Therefore special knowledge is required of the conditions of the transportation system in which driving (and riding) behaviour takes place. In addition, basic knowledge of the fields of clinical, social and health psychology as well as differential psychology is the pre-condition. Only on the basis of such scientific knowledge reliable assumptions on the capacity, behaviour and attitudes of drink drivers can be made.

At present, rehabilitation programmes are conducted in various European countries and have developed to a high professional standard in Germany and Austria. To outline the quantity of drivers addressed, the German example shows that some 150.000 drivers - equal to 0,4% of the driving population - are assessed annually.

Group-oriented courses related to DUI (driving under influence) have shown remarkable effects, exceeding individual treatment in reducing recidivism.

The results of the DRUID project indicate that rehabilitation measures like the Driver Improvement courses are effective and that there is an average reduction of relapse of 45,5%. Also the Austrian system of traffic psychological measures has been scientifically approved (Künzel et al., 2011).

Implementation, Transferability

Traffic-Psychological Assessment of Drink Drivers was recommended by the SUPREME Handbook for Implementation at Country Level (van Schagen, 2007). Cultural, social and legal differences of the different Member States must be taken into account.

Implementation requires capacity building in Traffic-Psychological Assessment, both for test equipment and qualified staff.

Costs and benefits

Statistics from Switzerland show that traffic accidents cost about 5 billion Euros per year, one fatal accidents cause costs of 1 million Euros.

http://www.bfu.ch/German/medien/Seiten/2008_01_22.aspx

Priorities

In general, Traffic-Psychological Assessment of Drink Drivers should be part of any licensing system, but it is not suitable to be implemented solely for PTW riders.

15. Post Accident Care

Improve Emergency and Post-Injuries Services

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★☆☆	Sustainability	★★★★★

Improving the emergency and post-injury services includes a set of different measures, including

- first aid (see measure "Motorcycle Issues in Emergency and First Aid Trainings")
- emergency call (see measure "e-Call")
- efficient response of emergency systems
- security and safeguarding of accident sites
- transportation and medical treatment to enable a transport of the victims
- further medical treatment and psychological support

Example:

The European Commission will develop the elements of a global strategy of action concerning road injuries and first aid, with the help of a Task Force bringing together the relevant actors, representatives of international and non-governmental organizations, government experts and the European Commission.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.10, *http://ec.europa.eu/transport/road_safety/pdf/com_20072010_en.pdf*

More examples are described within the SUPREME Thematic Report on Post Accident Care (Fiala & Kaiser, 2007).

Beneficiaries:

This measure is not directly addressed to PTW riders as it includes all road users. Nevertheless, PTW rider would significantly benefit from improved emergency and post-injuries services.

Clear definition of the problem

The measure shall reduce fatality rates, injury severity, costs of medical treatment and rehabilitation by improving the quality of rescue services.

Size of the problem, Expected impact

Emergency rescue services concern almost any victim injured in a traffic accident. Many studies have been carried out to determine a relation between rescue time and injury severity or fatality rates. None of these studies could deliver a clear relation in mathematical terms, but there is clear evidence that shortening the period from the accident to beginning of qualified medical treatment is effective in terms of reducing fatality rates and injury severity after road traffic accidents.

Implementation

Implementing an emergency rescue system is a long process. It may be considered that such services are available in all countries to a certain extent. However, building such a system is not an issue of PTW safety.

Acceptance

Costs of running such a system may be an issue for those who have to pay. I would be completely irrational trying to set up such a system just for PTW riders. On the contrary, such systems are a core element of the public health system.

Costs and benefits

It seems impossible to determine, which share of the public health system has to be accounted for road accidents, any information of this kind is missing.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, and recommend providing emergency services with the equipment and training to properly care for injured motorcyclists (e.g. how to safely remove a helmet).

Priorities

The European Commission has made improvement emergency and post-injuries services one of its seven strategic objectives.

Motorcycle Issues in Emergency and First Aid Trainings

Expert Assessment			
Overall		★★★★★	
Size	★★★★☆	Transferability	★★☆☆☆
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★☆

This measure involves medical personnel receiving appropriate training that involves PTW riders' needs when having had an accident such as removing a helmet in the correct manner.

In case of emergency it is important that the emergency medical personnel are prepared for the specific needs of motorcyclists.

Figure 86: Proper helmet removal training[81]

Example:

The Authors of the National Agenda for Motorcycle Safety published by the U.S. Department of Transportation detected that emergency medical personnel may not always recognize the predictable injury patters of motorcyclists. There is still a lack of information concerning issues, such as proper

[81] Source: http://www.oeamtc.at/netautor/pages/resshp/anwendg/1105213.html, 27 Aug. 2009

helmet removal techniques in the field of first-aiders. Therefore, this Agenda proposes that the medical personnel training must include information specific to the medical needs of injured motorcyclists. Also a motorcyclist treatment component in first-aid care training should be integrated.

U.S. Department of Transportation (2001). National Agenda for Motorcycle Safety, p.57

Beneficiaries:

With a rapid and appropriate emergency medical response it is possible to limit deaths and to mitigate the medical consequences resulting from crashes.

Clear definition of the problem

The problem solved involves the lack of training of medical personnel on the additional specific injury patterns of riders and the of the way riders should be treated in the accident scene by emergency personnel.

Size of the problem, Scientific Background, Expected impact, Costs and benefits

No evidence could be found addressing impact, costs or benefits of this measure.

Implementation, Transferability

Critical issues to consider involve the additional contents of the training which should be based on PTW riders' "bad" or inadequate treatment at the scene of the accident, in the ambulance and at hospital. In addition it could be of great importance if such first aid information is also provided to riders so that they also know how to react after an accident in relation to their injuries or to the ones of pillion passengers or vice versa.

If the measure only targets medical/emergency personnel, awareness will be raised from the places (usually hospital) where the personnel work. IF the measure also targets PTW riding population, awareness can also be raised through the media, motorcycling clubs, training schools etc.

Before implementation can be started, harmonised and scientifically approved methods of particular PTW rider treatment (e.g. helmet removal) have to be agreed upon.

Acceptance

Acceptance is solely an issue of rescue service providers.

Sustainability

The measure is anticipated to be sustainable, if rescue personal is periodically retrained in the issue.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it can help reduce the consequences of accidents.

Priority

It is reasonable for PTW riders to claim equal consideration of their needs compared to other road users. Hence, rescue measures particular to injured PTW riders cannot be neglected. It is recommended to include rescue manuals particular to PTW riders not only in training of medical/emergency personnel but also in training of laymen - at least in the few countries where such training is mandatory for all driving license holders.

Helmet Removal System

Expert Assessment			
Overall		★★★★☆	
Size	★★★☆☆	Transferability	★★☆☆☆
Total impact	★★★☆☆	Implementation	★★★★☆
Safety impact	★★★☆☆	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

A helmet removal system is a tool which helps removing a PTW rider's helmet after an accident. Instead of pulling off the helmet, a device is either moved in between the helmet ant the skull, or is already in place there. This device is blown up by a hand pump and hereby pushes the helmet off the head.

http://www.roadsafety.mccofnsw.org.au/a/91.html

Example:

Mainly for sports competitions, the company “Shock Doctor” offers a helmet removal system, which helps first responders to remove a proper-fitting full face helmet quickly and safely when neck and spine injuries are suspected. This way, EMS can safely reach a rider’s airway to provide the best possible care. The system is available in two versions: The “Eject Helmet Removal System” is a matchbox-sized air bladder with an attached hose that is installed in-helmet before competition. If a crash occurs, the hose is inflated to push the helmet off of a rider’s head. The “EMT/First Responder Helmet Removal System” is a unit that is inserted past the forehead of the rider when an Eject in-helmet unit is not present.

http://www.ejectsafety.com/home.html

Beneficiaries:

Especially PTW riders in sport competitions benefit from such helmet removal systems, as it reduces any traction on the spine which can further injure a rider with spinal injuries. But also EMS gain a benefit from this measure because they can safely reach the crashed rider’s airway to provide the best possible care.

Figure 87: Eject Helmet Removal System Procedure[82]

Clear definition of the problem, Size of the problem, Scientific Background, Expected impact

PTW riders might sustain additional injuries caused by the removal of the helmet.

This measure has a potential to improve rescue service and emergency treatment after PTW crashes avoiding additional injury caused by these operations.

There is no evidence, how often helmet removal causes additional injury and no evidence, to which extent a helmet removal system could avoid or mitigate severity of such injuries.

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[82] Source: http://www.ejectsafety.com/pdf/Consumer-IFU.pdf, 30 Sep.2010

Implementation

Rescue forces would have to be equipped with such devices and trained in using them.

Standards of rescue services would have to be adopted.

Acceptance

In case, such systems are mounted to the helmet, manufacturers are concerned. Riders might object to mandatory implementation of such systems due to additional cost. They might be convinces by sound scientific proof of effectiveness and efficiency.

In case of systems to be used by rescue services, no other stakeholders are concerned.

Sustainability

For the example mentioned above, the inflatable device has to be replaced every two years.

Transferability

The measure can implemented wherever specialized rescue services exist.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it can help reduce the consequences of accidents.

Priorities

This measure receives appreciation by the experts. However, according to the existing evidence, studies on effects and efficiency would be required.

16. Road Safety Data and Data Collection

Improvement of Data Collection

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★☆☆
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

There is a lack of comprehensive data and research evidence about PTWs from a road safety perspective and as a sustainable form of transport. This ranges from limitations in crash data reporting and collection, to the uncertainty about the effectiveness of a range of safety related activities. There is also a need for a better understanding of the growth in PTW use, through research into the types and destinations of trips taken, reasons for these (e.g. for commuting and/or recreation) and the socio-demographic characteristics of riders and pillion passengers.

Examples:

In Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers, the improvement of the data collection is listed as one of the main targets. This aim is divided into three initiatives:

- Improve the quality and accuracy of PTW crash and transport data that is collected, and make this available for planning and policy development purposes, as well as for the development of effective safety countermeasures and strategies around mobility.
- Disseminate relevant PTW safety and transport information, including research findings, to riders and other key stakeholders.
- Improve the exchange of information and data across government agencies around PTW safety and transport issues and initiatives.

http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/Motorcycles/VictoriasRoadSafetyAndTransportStrategicActionPlanForPoweredTwoWheelers.htm

According to the National Agenda for Motorcycle Safety published by the U.S. Department of Transportation, the insurance industry could also create a system for collecting loss data that can be used to devise safety countermeasures. Subsequently, this motorcycle-specific loss data could be collected, organized, analyzed, and distributed to better understand safety issues, and to educate riders and other motorists on motorcycling safety issues.

U.S. Department of Transportation (2001). National Agenda for Motorcycle Safety, pp.33-34

In the USA, a voluntary guideline called "Model Minimum Uniform Crash Criteria" (MMUCC) has been developed. Its purpose is to provide a dataset for describing crashes of motor vehicles in transport on a roadway that will generate the information necessary to improve highway safety within each State and nationally. MMUCC represents a voluntary and collaborative effort to generate uniform crash data that are accurate, reliable and credible for data-driven highway safety decisions within a State, between States, and at the national level. MMUCC was originally developed in response to requests by States interested in improving and standardizing their State crash data. Lack of uniform reporting made the sharing and comparison of State crash data difficult. Different elements and definitions resulted in incomplete data and misleading results. MMUCC recommends voluntary implementation of a "minimum set" of standardized data elements to promote comparability of data within the highway safety community. It serves as a foundation for State crash data systems.

http://www.mmucc.us/2008MMUCCGuideline.pdf

It has been shown that the travel patterns of motorcycle riders, with respect to rider age, are quite different from other road users, both in the number of annual miles driven as well as the average trip duration. This strongly suggests that special attention needs to be given to the collection of accurate motorcycle rider exposure data.

TRB (2008). Volume 22: A Guide for Addressing Collisions Involving Motorcycles, p.V-113

ERF – IRF BPS suggests that a new statistical tool should be developed, which is specifically aimed at gathering information on PTW accidents to ascertain the different factors which play a role in real-life conditions.

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.10

Beneficiaries:

Comprehensive data will enable market segmentation so that initiatives and actions can be targeted more effectively. Besides, based on this data, safety policy and action plans can be designed more precisely concerning the various target groups.

Clear definition of the problem

Accident Research incorporates the study of macro and micro accident databases studies with respect to the casualty population. Macro studies record and investigate road accidents at a national and international level, whereas micro studies utilize in-depth and forensic investigation techniques to examine a much smaller number of crashes, but to a much greater level of detail. To successfully tackle the future motorcycle casualty problem it will be necessary to combine the macro and micro data to formulate strategies.

There is reasonable recording across Europe at a macro level with police gathering data on injury collisions, but there is very little in-depth or micro data collected.

The only large on-going programme in Europe that investigates all injury severity accidents at the scene and collects micro data is the German In Depth Accident Study (GIDAS). The dearth of micro data means that it is very difficult to make scientific judgments based on real-world accidents where detailed knowledge of their characteristics and causes are needed.

There is very little good quality exposure data across Europe that describes motorcyclists travel patterns and behaviours.

Size of the problem

When the magnitude of data collection 'problems' are considered, there are arguably two parts to discuss:

- firstly, there is always scope to improve the quality of the data that is currently collected, primarily by the police (macro); and
- there is a scientific need for more information that describes what actually occurs before, during and after collisions in a very detailed way – more in-depth data collection (micro).

It is not practicable to define the size of these problems, perhaps other than the main priority, which in my opinion, is to initiate a number of in-depth data collection projects across Europe to begin to fill the gaps in our knowledge regarding why crashes happen and to identify genuine remedial measures.

Scientific Background

Data has been collected for many years and comprehensive literature is available which describes what to collect and how to collect it. These methodological studies have developed over many years, as the science of accident investigation and analysis has matured. Recent examples from the UK include the On The Spot Accident Data Collection Study reports – Phases I, II and III. Further, there are specialist accident reconstruction journals that cover forensic investigation techniques and encompass modern technologies such as anti-lock brakes.

Standard software can be bought to collect national macro casualty data, e.g. iMAAP.

Implementation

Large scale macro data collection has few barriers and is generally collected as a matter of course by authorities.

There are no major technical issues to prevent macro or micro data collection data collection, because the methods and science are now relatively mature. However, the costs and timescales of in-depth micro programmes would need to be well understood and to be well defined to ensure a successful implementation. These costs are probably the major barrier. Also, evaluation would be essential to measure whether the programme was effective, to ensure the sample size and data collected was fit for purpose and met the requirements of the safety professionals.

The importance if in-depth data should be raised through this and other projects to highlight the level of uncertainty that sometimes occurs due to lack of information.

Expected Impact(s)

The likely impacts could be significant as improved data collection would provide road safety researchers with vital data and evidence upon which to base their investigations.

Acceptance

Acceptance is likely to be high for all stakeholders, especially if the programmes can be shown to be cost effective. The potential exception is industry, infrastructure providers and public authorities who may find that they have to fund the data improvements and therefore this could influence their levels of enthusiasm. There is a difficulty with data collection programmes in highlighting their value and benefits, often because these are large complex programmes with many different studies individually benefitting from the data. The benefactor is not necessarily the organization who funds the work, for example where a transport safety department sponsors the data collection; the principal benefit may be the health department where less serious injuries need treating. Traditionally these complex relationships have not been well understood and this can lead to data collection projects appearing expensive, when in reality they are cost beneficial. This is equally true for exposure data.

Sustainability

There is a need for on-going monitoring of road casualties and improvements to data collection programmes could improve the quality and quantity of data collected at the macro level.

Similarly, for micro data and exposure data collection, ideally these programmes should run for years and provide an opportunity to track trends over time.

Transferability

Implementations of such measures are clearly possible across Europe and it is vital that harmonized data is collected to allow meaningful comparisons and to pool evidence.

Costs and benefits

No specific studies have addressed the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, as it can provide valuable information on motorcycle use, rider profiles and exposure data in different regions, which can then be used to identify areas for action, support PTW mobility where it helps fight congestion and air pollution, and design safety measures adapted to the needs of motorcyclists.

Priorities

Acquisition of additional and better data about PTW accidents, mobility and other issues should receive top priority. Low ratings on transferability and implementation appear as a matter of fact, since information that would be easily accessible would have been acquired already. Execution of 2BESAFE is one element of the activities covered by this measure.

It has to be highlighted that research and data acquisition are not an end in itself; there are a necessary prerequisite for development and implementation of effective and efficient injury countermeasures.

Road Conflict Investigation

Expert Assessment			
Overall		★★★★☆	
Size	★★★★★	Transferability	★☆☆☆☆
Total impact	★★★★☆	Implementation	★★★☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

Road Conflict Investigations need to be seen as an addition to Road Safety Inspections. Conflicts are observed and on the basis of those observations, deficiencies of the specific road combined with erratic behaviour of the PTW rider are analyzed. The main advantage of this measure is the frequent occurrence of conflicts in the daily volume of traffic. Road Conflict Investigations just like RSI result in reconstruction activities which must be evaluated afterwards, but in contrast to them, Road Conflict Investigations do not only focus on the infrastructure but also on road deficiencies concerning conflicts between different road users.

Example:

In Austria, Road Conflict Investigations are conducted. These Investigations are regulated by the RVS 02.02.22. The guideline was implemented in 1995.

Beneficiaries:

PTW riders as well as other road users benefit from this measure as it enhances the safety of specific conflict spots. Doing this, it is targeted on the number of conflicts, the overall crash severity, the PTW rider injury severity of specific conflict types and identification of accident blackspots.

Clear definition of the problem

Road conflict investigations are not universally carried out across Europe and there are different criteria under which a police officer or another official would instigate such an enquiry. In the UK, only life threatening or fatal crashes would trigger an in-depth forensic investigation involving detailed photographs of the scene, mapping of the crash partners and environment (scene plan), collection of witness statements and a detailed reconstruction of events.

For motorcycle collisions there are further complications when it comes to the reconstruction, as specialist techniques are required to account for the motorcycle and riders characteristics.

Therefore, in summary:

- different levels of road conflict investigation are carried out by the authorities across Europe with respect to their scope and scale;
- different types of collision criteria are used to instigate a road conflict investigation;
- motorcyclist collisions require specialists bespoke conflict investigation techniques; and
- the road conflict investigations are typically undertaken to identify culpability and are not made widely available for research purposes. Therefore these individual investigations remain isolated and are not collated and compared through analysis. This acts as a barrier to learning more about the nature and underlying factors of these very serious crashes and thus is a waste of a valuable evidence base which could be used to prevent future such tragedies.

Size of the problem

Ex-ante determination of the share of PTW accidents, injuries and fatalities that can be affected by a research method is, by nature, impossible.

Scientific Background

Data has been collected for many years and comprehensive literature is available which describes what to collect and how to collect it. These methodological studies have developed over time, as the science of accident investigation and analysis has matured. Further, there are specialist accident reconstruction journals that cover forensic investigation techniques and encompass modern technologies such as anti-lock brakes.

Implementation

There are no major technical issues to prevent more and better road conflict investigation, because the methods and science are now relatively mature. However, the costs and timescales would need to be understood and to be well defined to ensure a successful implementation. These costs are probably the major barrier. Also, evaluation would be essential to measure whether the programme was effective.

Implementation may be helped if the data collected could be anonymised and made more widely available to safety professionals for analysis, where they could begin to compare different motorcycle accidents and identify similarities. This would genuinely help to establish the priorities for future collision and/or injury prevention because this evidence base could be compared to the effectiveness of any potential countermeasure(s) and informed decisions made on the likely outcomes.

Expected Impact(s)

The expected impact is nothing more or less than improving and extending knowledge about PTW rider behaviour, which is an inevitable prerequisite for development and implementation of new and improved injury countermeasures.

Acceptance

Acceptance is likely to be high for all stakeholders, especially if the programmes can be shown to be cost effective. The potential exception is public authorities who may find that they have to fund the road conflict investigations and therefore this could influence their levels of enthusiasm. There is a difficulty with data collection programmes in highlighting their value and benefits, often because these are large complex programmes with many different studies individually benefitting from the data. The benefactor is not necessarily the organization who funds the work, for example where a law enforcement safety department sponsors the road conflict investigation; the principal benefit may be the health department where less serious injuries need treating.

Sustainability

There is a need for on-going monitoring of road casualties and improvements to road conflict investigations could improve the quality and quantity of data collected.

Transferability

Implementations of such measures are clearly possible across Europe and it is vital that harmonized road conflict investigations are undertaken to allow meaningful comparisons and to pool evidence.

Costs and benefits

No specific studies have addressed the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, as it can provide valuable information on near misses and successful accident avoidance strategies used by riders, which can then be used to design safety measures and improve rider and driver training.

Priorities

Conflict observation is an inevitable element of research on PTW safety. The method may be difficult to implement, but it is considered very rich in terms of acquisition of additional knowledge on PTW rider behaviour.

Naturalistic Riding

Expert Assessment			
Overall		★★★★☆	
Size	★★★★☆	Transferability	☆☆☆☆☆
Total impact	★★★★☆	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★☆

Statistics show that PTW users are increasingly "over-represented" in fatal crashes. According to the OECD/ECMT International Road Accident Database, in 2002, they comprised 11.3% of all road fatalities in European countries. By 2005, that figure had increased to 13,4%. Although the total numbers of PTW riders slightly decrease, they result in higher share due to the steep decrease of car driver fatalities. The main cause of accidents with PTWs is the failure of other drivers to perceive them, but their own errors are also a contributing factor in many crashes. To learn more about why accidents happen, investigations in the natural surround of the driver – called Naturalistic Driving Studies – are conducted. These studies thus do not have an experimental approach but try to collect descriptive mass data concerning common driving behaviour. Naturalistic Driving Studies are an important part of driver-based data.

Examples:

In the course of 2BESAFE, a Naturalistic Riding pilot study was carried out. PTWs were fitted with special equipment and sensors in the UK, France, Italy and Greece. Typical two-wheelers, depending on the partner country, were used. Miniature sensors will record throttle and accelerometer position, handlebar rotation, operation of hand and foot brake levers, foot peg pressure and turn signal operation. In addition, a gyroscope and GPS equipment will record position and orientation, and a video camera will record the visual context.

All instruments were installed discretely. The 'hiding' of the sensors is essential to ensure that other road users behave normally when they see the bike. Nor should the rider himself be aware of the sensors as he rides the PTW. This way, the maintenance of normal handling and safety is guaranteed. The riders will be observed for six weeks, during which they will hopefully forget that they're being watched.

http://www.2besafe.eu/

In 2011, another Naturalistic Driving Study started in the United States of America. The Motorcycle Safety Foundation (MSF) and its members will conduct in cooperation with the Virginia Tech Transportation Institute (VTTI) the MSF Naturalistic Study of Motorcyclists.

http://www.msf-usa.org/index_new.cfm?pagename=News&action=display&content=B5A4E707-C291-4619-4D399881D6901B75

Beneficiaries:

Naturalistic Driving Studies generate a huge amount of raw data concerning the behaviour of motorcycle and moped drivers. Science will be given a unique and extremely valuable database. Certainly, creating such a database is not an end in itself. Scientists aim at gaining a deeper understanding of PTW riders' behaviour in able to develop a new generation of safety measures.

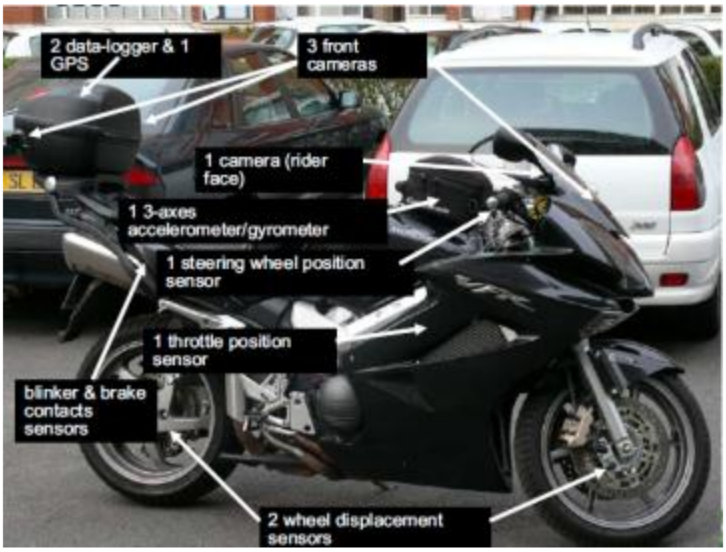

Figure 88: PTW instruments and data logger used for Naturalistic Driving[83]

Clear definition of the problem

Typically, in a naturalistic observation study passenger cars, generally the subjects' own cars, are equipped with devices that continuously monitor various aspects of driving behaviour, including information about vehicle movements - e.g. acceleration, deceleration, position on the road, driving speed -, about the driver - e.g. eye, head and hand movements -, and about the direct environment - e.g. traffic densities, time headway, road and weather conditions (source PROLOGUE project website)

Size of the problem

Naturalistic riding addresses possible shortcomings and limitations of controlled experimental research; particularly, a wealth of environmental factors which determine specific events (including accidents) is missing in laboratory or test track environments. A deeper insight into the reasons of riders' behaviour is thereby possible.

Scientific Background

This approach has been applied to the automotive domain both in Europe and in the US, on both the small and the large scale (e.g.: the "100 Car Study" at VTTI). Before 2BESAFE started, the only known application of this approach to the motorcycles domain was attempted by VTTI between 2010 and 2011, funded by the Motorcycle Safety Foundation (see http://www.vtti.vt.edu/1-Pagers%20for%20Website/CASR_Hankey/MSFs%20100%20Motorcyclist%20Naturalistic%20Study.pdf).

The naturalistic approach allows researchers to collect data about the riders' behaviour and the context around them in the least intrusive way. The measure is not addressing a specific problem, but is a powerful tool for reconstructing the riding activity, especially in the mid- and long-run, on a large enough amount of data.

Naturalistic riding does not tackle a specific problem, but provides a method for addressing those which are hardly addressable in a controlled experimental environment.

Implementation

Naturalistic studies are expensive and time consuming. Vehicles are required to be equipped with recording equipment (sensors, data loggers, cameras and so on). Vast amounts of data can be collected which must then be analyzed. A central principal of the approach is that riders conduct their normal journeys in their normal manner. As collisions or conflicts are relatively rare and irregular events a lot of data collected may be relatively mundane and uninformative. Though allowing analysis

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[83] Source: www.vti.se/13832.epibrw, 19 Aug.2010

of normal riding style, it might be that behaviour and performance immediately prior to, and during, conflicts are more informative for designers and regulators.

Methods for data storage, download and analysis need to be carefully considered.

There are difficult ethical and legal considerations to be addressed in establishing naturalistic riding styles.

A potential benefit of ND studies is the ability to compare behaviour and performance in different countries and therefore analyze the influence of different traffic conditions and regulations. However it may be difficult to make direct comparisons as many other factors may also vary concurrently; such as terrain, weather conditions, traffic mix, insurance incentives and so on.

A paramount consideration is the size of study needed for sufficient data to enable an informative analysis.

Greater acceptance of the ND approach may accrue if it is shown that such studies have a strong contribution to the current important safety debates about factors such as driver/rider distraction and fatigue.

Expected Impact(s)

As a research tool, benefits across the areas can be obtained. No direct impact can be expected, besides a better understanding of the problems being addressed.

A naturalistic riding study would pay in the long run, providing evidences for supporting policy decisions or to accept vs. reject the introduction of a specific technology.

As a methodology, Naturalistic Riding entails scientific or technical problems, not safety-related criticalities.

Acceptance

Naturalistic Studies are an issue of science. Other groups are only affected as far as they are concerned with research funding. Within the scientific world, naturalistic studies are currently considered as the most promising approach in solving current and further problem in traffic safety and also address issues of environment protection and traffic management.

Transferability

Implementation of a ND study is a rather difficult, time consuming and expensive activity. However, it may be assumed the anywhere in the world there are experts being capable of running a ND study. Funding a critical issue, since road safety research do normally not create any results which can be marketed and provide return on investment.

Costs and benefits

This is an emerging approach and lessons are still being learned about the most cost effective ways of conduct studies. Much of the variance in studies is focused on the range and fidelity of data collection and the length of the study. AS yet there has not been a definitive assessment of cost benefit and cost effectiveness of the approach

Riders' perspective

★★★★★

The riders' associations strongly support this measure, as it can provide valuable information on rider and driver behaviour, rider profiles and exposure data in different regions, which can then be used to identify areas for action and design safety measures adapted to the needs of motorcyclists.

Priorities

As the results from WP2 of 2BESAFE show, naturalistic studies on PTW rider behaviour are most promising.

Field Operational Tests

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★☆☆☆☆
Total impact	★★★★☆	Implementation	★☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★★☆	Sustainability	★★★★☆

Field Operational Tests (FOT) are large-scale testing programmes aiming at a comprehensive assessment of the efficiency, quality, robustness and acceptance of ICT solutions used for smarter, safer and cleaner and more comfortable transport solutions, such as navigation and traffic information, advanced driver assistance and cooperative systems. Any other particular feature of a vehicle can be tested, where comparison of driving behaviour "with" and "without" this feature is reasonable.

The method is somewhat close to naturalistic observation, typical vehicle instrumentation is similar and expertise needed for data analysis is the same. However, FOTs typically aim at testing a single feature of a vehicle instead of providing a database for later analysis; they typically have a shorter observation period and instrumentation may be more specific - instead of being "general purpose" as for naturalistic studies.

http://www.fot-net.eu/

Example:

The UK ISA project began in January 2001 and had duration of 72 months. Intelligent Speed Adaptation is a system that provides, within the vehicle, information of the speed limit for the road currently being travelled on. This technology was of interest because of the known relationship between speed and risk of an accident and also because of the relationship between speed and injury severity in an accident. Important issues covered were how different types of driver would be affected in terms of speed choice by use of the system; other work in the project has examined the feasibility of building a motorcycle with ISA. Adapting ISA to a motorcycle environment was a challenging proposition both in terms of the need to minimize weight and system volume and because of the requirement to consider the very different vehicle dynamics of a motorcycle. A demonstration ISA motorcycle was created that has offered a reliable, safe and effective vehicle for riding in user assessment trials within a test track environment.

http://www.eurofot-ip.eu/en/the_project/about_field_testing/

Beneficiaries:

Previous experience in Europe, US, and Japan has shown that field trials are an excellent way to raise awareness, collect real data, and enhance the take-up of ICT solutions. Field Operational Tests have also proved to be a powerful tool for gaining insight into the way new functions and systems suit the user when operated in the real context and for a sufficient long time to have statistically sound data.

Figure 89: ISA on a motorcycle[84]

Clear definition of the problem

Any new system needs evaluation at different stages of the design cycle. A field operational test is required for systems that require behavioural data from real users before decisions can be made about wide scale deployment. Typically FOTs are relevant for systems that are technically complex and which involve a range of stakeholders.

The true value or difficulties with many systems can only be known once users have had sufficient expose to the system for natural usage patterns to emerge.

Size of the problem

FOTs are particularly relevant for emerging ADAS and vehicle and infrastructure communications systems. Nearly all current and recent FOTs in Europe focused on car drivers are also relevant to PTWs.

Scientific Background

Many European collaborative projects have focused on refining and justifying prescriptive approaches to FOTs. FESTA and ADVISORS are examples. TeleFOT and EuroFOT are large scale FOT currently (in 2011) ongoing, which aim at analysing the impact of several different driver assistance systems.

It has been argued by some safety experts that relatively little attention has been paid to the specific needs of PTWs and other vulnerable road users.

Implementation

Strong efforts have been undertaken to explore feasibility of FOTs and define a common understanding of how FOTs should be carried out. Guidelines have been prepared, which widely cover relevant issues, for example FESTA manual. Nevertheless, FOT require large investment in equipment for data collection, data storage and data analysis; data analysis requires a lot of experience; data protection, security and privacy have to be carefully considered.

www.fot-net.eu/en/library/deliverables/

Acceptance

FOTs are an issue of industry and science. Other groups are only affected as far as they are concerned with research funding. Among experts, FOTs are currently considered as the most promising approach for evaluation of the impact of new vehicle feature, which aim at influencing driver behaviour or supporting the driver. In particular, this method is required if the effect of a feature cannot be reasonably reproduced in controlled experiments.

Sustainability

Considering that the "impact" of an FOT is additional knowledge about how drivers and riders interact with particular features of a vehicle, the effect is as sustainable as it is made by study design. I.e., with respect to the expected impact of a particular feature, the method has to be adapted in terms of instrumentation, number of subjects and observation period. Some uncertainty will always remain, if unexpected effects occur, which range beyond the observation period.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, because it is an essential part of the design of safe and reliable ITS solutions that answer the safety needs of riders, and remain compatible with the needs, characteristics and limitations of PTWs.

[84] Source: Simpkin B. et al. (2007). ISA – UK Results of Motorcycle Trial, p.18

Priorities

It may be assumed the FOTs are currently the most powerful methodology of assessing the effects of particular vehicle features. However, a general rating cannot be provided and assessment has to be made on a case by case basis.

In-Depth Analysis of Motorcycle Accidents

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★☆☆☆
Total impact	★★★★★	Implementation	★★☆☆☆
Safety impact	★★★★★	Acceptance	★★★★★
Efficiency	★★★★★	Sustainability	★★★★★

Previously, not enough information was available to develop an integrated safety policy and an action plan. There was a need for an in-depth analysis of motorcycle accidents, where each case is investigated in detail. The investigation should include a full reconstruction of the accident and the identification of all human, environment and vehicle accident contributing factors.

Example:

MAIDS (Motorcycle Accidents In-Depth Study) is the most comprehensive in-depth data currently available for PTW accidents in Europe. The investigation was conducted for a time span of three years on 921 accidents from five countries using the OECD common research methodology. Beside other acknowledgements, the study indicates that – after the passenger car – the roadway itself is the obstacle PTWs most likely crash into. Publications in the Netherlands, Norway, the United Kingdom, Belgium, France and Germany show that a civil engineering handbook may well be a helpful instrument for improving traffic safety for PTWs. Therefore, ACEM taking into account the conclusions of the MAIDS study took the initiative to integrate the existing national handbooks into one European handbook. To further broaden the scope of this handbook, information of two Eastern European countries – Poland and Bulgaria – are included whenever deemed appropriate.

http://www.maids-study.eu/

Beneficiaries:

In-depth accident investigations give detailed information about vehicle factors (accident causation, vehicle population), environmental factors (accident causation, worsening factors) and human factors (e.g. accident causation, accident population, collision dynamics, injuries). The results must be considered when safety policy and action plans are designed, so that all road users are included.

Figure 90: Logo of the motorcycle accidents in-depth study “MAIDS”[85]

Clear definition of the problem

Generally speaking, road safety research aims at understanding road user behaviour and using this knowledge to improve safety. A very common approach of improving safety is research on "unsafety", i.e. the negative consequences. In terms of road safety, this means analysing crashes. National accident statistics - typically based on police reports - offer a lot of information to do so, but information about single events is rather limited. Researchers need more detailed information about single events to conclude on e.g. crash contributing factors. In-depth analysis provides a huge amount of information on single events.

[85] Source: http://www.maids-study.eu/, 13 Sep.2010

Currently, there is only a limited amount of high quality in-depth data available on PTW accidents.

Size of the problem, Expected Impact(s)

In principle, in-depth analysis addresses all PTW-related accidents. It is unknown, to which extent the knowledge acquired by in-depth analysis will contribute to improve PTW safety. But it is well acknowledged that in-depth analysis currently is the only method providing sound information on crash causation. More research in PTW safety, of which in-depth analysis is a key element, may help development of PTW accidents to catch up with the tremendous reductions of fatalities car occupants.

Scientific Background

There is evidence of good practice with respect to in-depth analysis of motorcycle accidents, some examples of the causes of collisions are given below:

In their in-depth study of motorcycle accidents, (Clarke, Ward, Bartle, & Truman, 2004) used police road accident files involving motorcyclists to construct a database containing the facts related to each case, prose accounts, sketch plans and possible explanatory factors for each incident. The following causes of collisions were identified:

- Right of way violations (ROWVs) occur mainly at T-junctions, and usually the motorcyclist is not at fault but rather the collision results from the car (or other vehicle) driver failing to see the motorcyclist.
- Losing control on bends. This is usually attributed to the motorcyclist, and mainly occurs when inexperienced riders are riding their motorcycle for pleasure on rural roads.
- The high power-to-weight ratio of motorcycles and associated maneuverability may be a contributory factor. Riders often ‘filter’ through slow or stationary traffic, and this may ‘subvert’ the expectations of other drivers regarding how traffic behaves.
- Rear end shunts, whereby the motorcyclist collides with the rear of another vehicle. These tend to involve young male riders and may result from riders finding it difficult to brake soon enough, particularly in wet or slippery road conditions.

The authors also found that motorcycles with an engine capacity of 50-125cc were over-represented in accidents. Bikes of this capacity are used most often by young, inexperienced riders. The primary cause of this type of collision tended to lie with the driver of the other vehicle (57% excluding single-vehicle accidents), while in 22% of cases it lay with the motorcyclist.

Huang and Preston (2004) conducted a literature review on motorcycle collisions and described additional factors contributing to accidents:

- Motorcycles are physically smaller than other motor vehicles. Their face-on silhouette area is 30-40% that of a car, and they are more likely to be obscured by traffic. (Horswill & Helman, 2001) found that people about to pull out from a junction tend to judge that an oncoming motorbike will reach them later than a car travelling at the same speed.
- There is a lower frequency of motorcycles on the road and so drivers do not expect to encounter them.
- Drivers have visual limitations such as in-vehicle obstructions (e.g. door pillars, passengers) and blind spots.

Motorcyclists may display aggressive or risk-taking behaviour, for example (Horswill & Helman, 2001) found that motorcyclists tended to choose faster speeds, overtook more and pulled into smaller gaps in traffic compared to car drivers. Young male riders are particularly likely to display risky behaviour.

(Elliot, et al., 2003) undertook a scoping study into motorcycle safety. This involved a review of literature and research as well as national accident figures. In addition to points mentioned above, the authors note that:

- Motorcycles are ‘single track’ vehicles and therefore at risk of becoming unstable and ‘capsizing’ if a wheel loses adhesion to the road surface, particularly if the vehicle is taking a bend.
- Motorcycles are particularly vulnerable to the design and condition of roads, with hazards such as pot holes, drain covers and uneven surfaces posing a potential danger to motorcyclists.
- Crash barriers are designed to reduce crash severity for other types of vehicles, but motorcyclists are vulnerable in impacts with crash barriers.

The Motorcycle Accidents In-depth Study (MAIDS) (ACEM, 2004) consisted of an extensive in-depth study of 921 accidents involving a motorcycle or moped in 1999-2000 in sampling areas in France, Germany, Netherlands, Spain and Italy. The investigation of each accident included an accident reconstruction, vehicle inspections, witness interviews and medical record collection (where possible). The study was case-controlled, with comparative information collected on a further 923 non-accident involved powered two wheelers. It was found that:

- Impact speed of motorcyclists was usually below 30mph; excess speed was rarely a contributory factor.
- Human error was the cause of the majority of incidents involving powered two wheelers, with 50% attributed to an error made by the driver of the other vehicle, and 37% by the powered two wheeler driver.
- The primary contributing factor in 37% of cases was a perception failure by the other driver.
- The majority of collisions were with a passenger car (60%) or the roadway (9%).
- Just over 15% of collisions did not involve another vehicle.
- Over half of collisions (54%) took place at an intersection.
- Road surface defects were present in 30% of cases.
- For L1 vehicles (two-wheeled vehicles with an engine cylinder capacity not exceeding 50cc and a maximum design speed not exceeding 50 km/h) some sort of tampering with the engine or driveline was detected in 17.8% of collisions.
- Helmets were effective at preventing or reducing head injury severity in 69% of cases.

Acceptance

Acceptance is likely to be high for all stakeholders, especially if the programmes can be shown to be cost effective. The potential exception is public authorities who may find that they have to fund the in-depth analysis and therefore this could influence their level of enthusiasm. There is a difficulty with data collection and analysis programmes in highlighting their value and benefits, often because these are large complex programmes with many different studies individually benefitting from the data. The benefactor is not necessarily the organization who funds the work, for example where a law enforcement safety department sponsors the road conflict investigation; the principal benefit may be the health department where less serious injuries need treating.

Sustainability

Once collected, in-depth data is there for analysis and can be used for a large number of purposes. It is one (additional) tool in the toolbox of road safety researchers, which is there - ready for use if needed. From this perspective, in-depth data collection is highly sustainable. However, in-depth data is most valuable if data collection is executed continuously or at least periodically for a reasonable sample of crashes.

Transferability

Implementations of such measures are clearly possible across Europe and it is vital that harmonized in-depth accident analysis is undertaken to allow meaningful comparisons to be made and to pool evidence and findings.

The EC-funded project DaCoTA currently develops a common European methodology of in-depth analysis.

Costs and benefits

No specific studies have addressed the costs and benefits of this measure.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, as it can provide valuable information on accident profiles and factors in different regions, which can then be used to identify areas for action, improve driver and rider training, and design safety measures adapted to the needs of motorcyclists.

Priorities

Acquisition of additional and better data about PTW accidents by in-depth analysis should receive top priority. Low ratings on transferability and implementation consider that in-depth data collection is costly and issues of data protection and privacy as well as cooperation with police and other rescue forces sometimes appears to be difficult to set up.

It has to be highlighted that research and data acquisition are not an end in itself; there are a necessary prerequisite for development and implementation of effective and efficient injury countermeasures.

17. Measures involving other Vehicles

Other Road Users' Responsibilities to Riders

Expert Assessment			
Overall		★★★★★	
Size	★★★★★	Transferability	★★★☆☆
Total impact	★★★★★	Implementation	★★★☆☆
Safety impact	★★★★★	Acceptance	★★★★☆
Efficiency	★★★★★	Sustainability	★★★★☆

Other vehicles are involved in about half of PTW serious casualty crashes. In a significant number of these crashes, the driver of the other vehicle is at fault; many involve the driver of a vehicle failing to give way at an intersection and turning across the path of a PTW travelling straight ahead. Hence, drivers need to understand the vulnerability of riders and pillion passengers in crashes with other vehicles; the importance of looking out for riders (especially at intersections) as well as that they must allow sufficient survival space when travelling near PTWs. Because many of the problems between car and PTWs could be prevented if car drivers:

- anticipated the presence of a PTW (when entering or crossing a road, when turning left and when changing lanes)
- were aware that judging the behaviour of a PTW may be difficult
- were aware of the problems of stability and handling of PTWs

Examples:

In the European Commission's policy orientations up to 2020, improving awareness of PTW riders by other road users is one of the actions which should be taken.

EC (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, p.12

In England, the new "THINK!" campaign run by the Department for Transport called "Named Riders" aims to reduce deaths and serious injuries amongst motorcyclists by humanising them in the eyes of car drivers. The campaign's message is that motorcyclists are a wide range of people, with names, personalities and families just like car drivers. Previous THINK! motorcycle campaigns have provided clear instruction for drivers in certain situations: "Mirror" in 2001 warned drivers to always look out for motorcyclists in their blind spots whilst "How close" in 2004 encouraged drivers to "Look, look and look again" at T-Junctions. The new campaign aims to take this idea one step further, by exploring the notion that awareness of motorcyclists can be increased by making drivers think more about the person riding the motorcycle. Developed in cooperation with key motorcycling stakeholders including the Motorcycle Industry Association, the British Motorcyclists Federation and the Motorcycle Action Group, the campaign is supported by television, cinema and radio advertisements.

http://www.dft.gov.uk/topics/road-safety/think/

FEBIAC, the Belgian Association reuniting manufacturers and importers of automobiles and PTWs, launched a campaign which shows the advantages of motorcycling in terms of door to door mobility. By placing large posters (saying "By the time you finish reading this, I'll be long home") on the back of trucks, FEBIAC's goal is to spark a reflection on the drawbacks of congestion and invite readers to consider PTWs as an alternative mode of transport capable of reducing travel times as well as traffic levels. Thus campaign targets car users, especially those who stuck in traffic jams. Besides showing the reduction of travel time, FEBIAC's intends to increase road safety. This way, the awareness of car users is raised and they are encouraged to look out for motorcyclists. Hence, a consistent safety message is bound to be beneficial to motorcycle riders

http://www.acem.eu/NWSL/newsl25/febiac.htm

In AIB's report on motorcycle accidents, it is recommended that campaigns should be directed at motorists based on the fact that motorcycles can be hard to see in time. When crossing and entering larger roads, motorists must be more aware before driving out. When turning left onto a side road, the motorist must always look behind himself to ensure there is no motorcycle about to overtake.

AIB (2009). Motorcycle Accidents, p.

In its discussion paper, the European Union Road Federation, the Brussels Programme Centre of the International Road Federation says that other road users also need to receive specific training to ensure they are aware of the different characteristics of PTWs. In particular, there is a need to train drivers to better spot PTW, as a considerable number of accidents between vehicle and PTW are due to the former's driver lack of perception of the latter.

ERF – IRF BPC (2009). Road Infrastructure Safety of Powered Two-Wheelers, p.8

In Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers, an awareness campaign is recommended to raise the other road users' responsibilities to riders. On the one hand, safe road user practices by drivers and riders should be carried out. On the other hand, the extreme vulnerability of PTW riders should be highlighted to all road users. Besides, according to this Action Plan, the judgments made by drivers that impact on safety for riders and pillion passengers, in particular at intersections, should be further researched.

httpwww.vicroads.vic.gov.auHomeMoreinfoandservicesMotorcyclesVictoriasRoadSafetyAndTransportStrategicActionPlanForPoweredTwoWheelers.htm

Beneficiaries:

The types of crashes described above, and others in which drivers are at fault, could potentially be avoided if drivers have a greater awareness of PTWs, make better judgments and take more responsibility in sharing the road safely with riders

Figure 91: Motorcycle awareness campaign[86]

Clear definition of the problem

Other vehicles are involved in about half of PTW serious casualty accidents. In a significant number of these crashes, the driver of the other vehicle is at fault; many involve the driver of a vehicle failing to give way at an intersection and turning across the path of a PTW travelling straight ahead. Hence, drivers need to understand the vulnerability of riders and pillion passengers in accidents with other vehicles, the importance of looking out for riders (especially at intersections) as well as that they must allow sufficient survival space when travelling near PTWs.

Size of the problem, Scientific Background

The size of the problem differs in different countries, but the problem is of high importance. Kramlich (2002) found that for 71.2% of collision between passenger cars and PTWs the passenger car driver is at fault.

A recently published study by Crundall, Clarke and Shanar supports previous findings (Magazzu` et al., 2006) that car drivers who are riders themselves ("dual drivers") are more effective in detecting motorcycles approaching a T-junction. The same study assumed that "look training" has a potential for the future, but the training schemes used within the study did not show an effect. Hence, it may be assumed that there is a potential of improving recognition of PTW riders at intersections by addressing other road users - if it is possible to change a drivers' skill of perceiving PTWs by riding a PTW oneself, there is a proof that such an improvement of perception skill is possible, however, a

[86] Source: http://news.uns.purdue.edu/images/+2006/mc-safety3.jpg, 05 Aug. 2010

successful tool has not been found so far (except PTW riding). A public awareness campaign might be a first step of improvement, at least paving the way for later interventions.

Implementation, Transferability

Awareness campaigns can be launched anywhere. It may be assumed that sufficient knowledge is available anywhere. Costs may be considered the bottleneck.

Expected Impact(s)

Awareness campaigns are a frequently applied tool for road safety improvement, but evaluation studies are rare and the results available are somewhat controversial. Awareness campaigns addressing all road users and particularly car drivers are likely to be more effective than a campaign of the same size addressing only PTW riders. In other words, an awareness campaign addressing a peaceful co-existence of PTW riders and other road users is likely to achieve improvement.

Acceptance

In terms of public awareness campaigns addressing all road users, the term "acceptance" might be understood differently. Acceptance by the general public may be considered as recognition of the campaign and likeability of the campaign to achieve behavioural changes within the target group (which should result in improvement of road safety). However, acceptance is also important for the group of stakeholders initiating, running and/or funding a campaign.

Sustainability

Little is known about sustainable effects of campaigns in general, no such information could be found on campaigns which promote PTW rider safety addressing another group of road users.

Costs and benefits

Elvik et al do not provide any cost-benefit figures, assuming that campaigns do not have effects if they are not combined with enforcement activities.

Riders' perspective

★★★★★

The riders' associations strongly support this measure, including training on PTW awareness and characteristics during driver training, because it offers the potential to significantly reduce the number of accidents and fatalities.

Priorities

The results of the assessment of this measure are somewhat controversial. On the one hand, peaceful co-existence and respect to other road users needs is generally considered a very important issue. Experts give high ratings for safety impact and total impact, but on the other hand there is little scientific evidence that public awareness campaigns have an impact at all. Although road safety campaigning is a very common tool, experts give low ratings on implementation and transferability.

Vulnerable Road User Protection

Expert Assessment			
Overall		★★★☆☆	
Size	★★★☆☆	Transferability	☆☆☆☆☆
Total impact	★★★★☆	Implementation	☆☆☆☆☆
Safety impact	★★★☆☆	Acceptance	★★★☆☆
Efficiency	★★★★☆	Sustainability	★★★★☆

Vulnerable road user protection systems help to prevent collisions and protect vulnerable road users such as pedestrians and cyclists. The sensor systems (often a combination of several sensor types) monitor the area in front of the vehicle, reliably detect vulnerable road users and distinguish them from other obstacles. The system uses different actuators which help avoid collisions or significantly mitigate their impact by reducing the speed of the vehicle before the collision. If a collision cannot be avoided, protective structural actuators can be triggered which reduce the chance of serious injuries or even save the lives of vulnerable road users.

Examples:

Autonomous braking systems usually use forward-looking sensors to predict emergency situations. They activate the brakes of the car shortly before the predicted impact. A reduction of the impact speed can lessen the injury severity of motorcyclists.

A warning device was designed in the WATCH-OVER project, which is based on the cooperation of communication and sensor technologies. It provides users with an in-vehicle module to warn drivers of approaching vulnerable road users (VRUs) on the one hand and wearable modules that call attention of VRUs to critical traffic situations on the other hand.

The pop-up bonnet was usually designed for pedestrians but this innovation in vehicle design could protect all vulnerable road users who are hit by the front of the vehicle. Usually, the bonnet is close to the engine and in the case of an impact, the bonnet is deformed. Stiff components represent a high injury risk for VRUs. Therefore, pop-up bonnets are designed to rise in an accident involving VRUs to soften the blow, absorb the head impact energy, and reduce the severity of the injury. Several manufacturers are developing these systems, which are often combined with external airbags.

At the international scientific conference “Enhanced Safety of Vehicles (ESV)”, Autoliv Inc. introduced two new airbags: SUVs are of particular concern for pedestrians due to their higher and more box-shaped fronts. The “Front Edge Airbag” addresses this problem. Triggered by a pre-crash sensor (such as radar), the airbag deploys a few milliseconds before a pedestrian impact. The Bumper Airbag for SUVs enhances pedestrian safety by deploying from beneath the bumper to protect the pedestrian’s legs. These external airbags could also have a positive effect in collisions with motorcycles.

http://ec.europa.eu/information_society/activities/intelligentcar/technologies/tech_17/index_en.htm

Beneficiaries:

Adapting passenger car fronts mitigates the injury severity of all kinds of vulnerable road users.

Figure 92: Pop-up bonnet in combination with an external airbag[87]

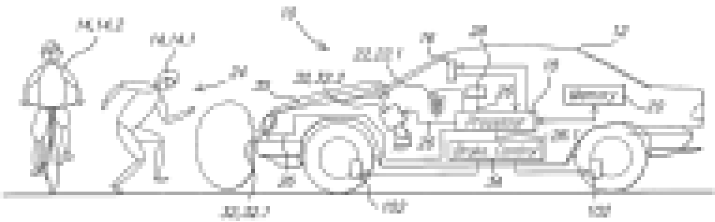

Figure 93: Example for a bumper airbag[88]

Clear definition of the problem

"Pedestrian friendly car fronts", regardless if they are realised by passive or active safety are likely to offer an effect of mitigation of injury also to PTW riders.

Size of the problem, Scientific Background

The maids study found (MAIDS, 2004, p57) found 10% of the collisions between cars and PTWs occurring between within an angle of 15° left and right to the car front (35% between 45° left and right to the car front). 60% of 921 accidents within the analysis were PTW of passenger car accidents. According to these results, pedestrian friendly car fronts would be relevant for 6% (front+/-15°) to 21% (front+/-45°) of all PTW accidents.

[87] Source: http://www.wired.com/autopia/2009/05/external-airbag-protects-pedestrians/, 24 Aug. 2009
[88] Source: http://www.wipo.int/pctdb/en/wo.jsp?wo=2006014974, 24 Aug. 2009

Expected impact

No information could be found, to which extent vulnerable road user protection systems reduce injury severity for PTW riders.

Implementation

The EU has implemented pedestrian friendly car front standards by Directive 2003/102/EC. This law has meanwhile been replaced by Regulation (EC) No 78/2009 of the European Parliament and of the Council of 14 January 2009 on the type-approval of motor vehicles with regard to the protection of pedestrians and other vulnerable road users, amending Directive 2007/46/EC and repealing Directives 2003/102/EC and 2005/66/EC.

To fit these rules, cars do not need active systems.

A different kind of implementation was done by consumer testing. The EuroNCAP test program included testing on pedestrian friendly car fronts, but does not address impacts of PTW riders. The pedestrian protection rating is provided separately and does not feed into an overall rating, which to a lower extent motivates manufacturers to improve pedestrian safety.

http://www.euroncap.com/Content-Web-Page/6019e175-a493-4cce-bb94-df5bee4656bb/pedestrian-protection.aspx

Acceptance

Before setting up this legislation, there were strong discussion about test methods between road safety organisations, the European Commission and car manufacturers.

This measure will not be accepted if only designed to protect PTW riders.

Sustainability

Neither fading nor any behavioural compensation can be expected.

Transferability

Practically, the car market is a global business. Currently, the implementation is only driven by consumer demand. A change to current technical rules would require a minimum size of a market, otherwise, manufacturers would not take the effort of developing active systems rather than avoiding the respective market.

Costs and benefits

No information could be found.

Riders' perspective

★★☆☆☆

The riders' associations support his measure insofar as the system is designed from the start to accommodate the needs, characteristics and vulnerabilities of PTWs along with those of other vulnerable road users. Systems that apply the brakes without intervention from the driver are not desirable because they foster overconfidence in drivers, and greatly increase the risk of rear-end collision with a following motorcyclist if the brakes are applied without warning and in conditions where another manoeuvre, such as avoiding the obstacle, could be safer.

Priorities

It may be assumed that by the existing European legislation on pedestrian friendly car fronts, a certain degree of protection is also offered to PTW riders. A change of this legislation only for the sake of PTW riders' safety is out of scope. The measure addresses a considerable share of PTW crashes. No evidence could be found about the preventive effect, but experts - according to their rating - are confident about a positive impact.

Collision Avoidance System

Expert Assessment

Overall		★★☆☆☆	
Size	★★★☆☆	Transferability	★☆☆☆☆
Total impact	★★★☆☆	Implementation	☆☆☆☆☆
Safety impact	★★★★☆	Acceptance	★★☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★☆☆☆

Collision avoidance warning systems are used to alert the driver to an imminent collision. Collision avoidance systems go further, they can react to situations where humans cannot or do not, due to driver error. The systems use relative distance, relative velocity and vehicle velocity information to warn the driver or control the vehicle.

Example:

No example concerning PTW as potential collision object could be found.

Beneficiaries:

Automatic or human on-time reaction in critical situations can reduce the severity or even the number of accidents. Automatic systems are designed to compensate for human error, if the rider fails to perceive a potential collision partner on time.

Clear definition of the problem

Collisions can be prevented by timely carrying out appropriate manoeuvres. Collision Avoidance Systems may prevent a crash by means of an active intervention on the motorcycle’s control, specifically on speeding, braking, steering behaviour.

Size of the problem

According to the MAIDS report, "69% of the OV [other vehicle] drivers attempted no collision avoidance manoeuvre" in motorcycle-OV crashes: this data suggests that riders should anticipate preventive actions, not relying on other road users’ counteractions.

Scientific Background

Data supporting the implementation of this specific measure are so far based on the automotive field. Previous research projects (e.g. PReVENT) have demonstrated that active safety systems may improve the efficiency and effectiveness of collision avoidance manoeuvres. Still, a sound application of the same concepts to the motorcycle domain is still to be attempted. It may prevent riders from undertaking wrong or inappropriate manoeuvres in critical situations. Still, the stability of the vehicle may be impaired and the loss of direct control from the rider may result in negative side effects. It aggressively tackles the basic problem, i.e. the very avoidance manoeuvre which would be delegated to the system.

Expected impact

It will support riders in be more aware and responding in critical situations. It is possible but only with sound scientific validation and support of policy makers and manufacturers. There could be a difference in acceptance according to the country, this contributing to the whole impact of the measure. As mentioned before, WP1 accident analysis support this evidence. In case the system is not accurate there is a risk of “crywolf” effect, that would turn out into a lack of attention by the rider towards the warning system. Moreover, the risk of losing control of the vehicle may be high.

Implementation, Acceptance, Transferability

On the one hand, implementation is rather easy: Such systems may be offered by manufacturers on the market. On the other hand, there is several barriers: Although such systems are already on the market, they are performing well and there is even a deadline for mandatory equipment for trucks and busses, PTW require additional features. For cars it is rather easy to allow activation of brakes for avoiding a collision. This cannot easily be done for PTW, considering that rapid reduction of speed requires additional activity by the rider, in particular during cornering. Brake activation coming as a surprise to the rider might even create additional risk, since the rider would have to change the roll angle of the vehicle accordingly.

Further, riders are a very sensitive group, when it comes to taking away vehicle control from them. Riders may require the possibility to override the system's decisions. Rider might argue that such a system is too obtrusive and keeps them out of the decisional loop.

Sustainability

Once installed and accurately maintained, such a system provides sustainable support to the rider. However, there is a certain risk of compensatory effects, which have to carefully assessed.

Costs and benefits

There is no information available.

Riders' perspective

★★☆☆☆

The riders' associations support his measure insofar as the system in all vehicles is designed from the start to accommodate the needs, characteristics and vulnerabilities of PTWs. In particular, PTWs should not be ignored or missed by collision alert systems in other vehicles because it would lull drivers into a false sense of security, and the system on PTWs should not apply human-independent action on the brakes or other controls, as it jeopardizes the rider's ability to stay in control of her vehicle, potentially leading to falls and fatal accidents.

Priorities

In principle, collision avoidance systems have a large potential of reducing number and severity of crashes, which is recognised with a high rating by experts. However, it seem that there are concerns of technical feasibility for systems, which fully consider the drivers's needs and the complex dynamics of PTW riding.

Inter-Vehicle Communication System

Expert Assessment			
Overall		★★☆☆☆	
Size	★★☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★★★☆	Implementation	☆☆☆☆☆
Safety impact	★★★★☆	Acceptance	★☆☆☆☆
Efficiency	★★☆☆☆	Sustainability	★★★☆☆

These systems provide alerts when crashes are deemed to be eminent by detecting and displaying information about other vehicles (relative speed, position, course, vehicle type).

Examples:

Honda and Yamaha developed inter-vehicle communication systems within the Project ASV-2. The systems consist out of a navigation unit display which shows the vehicles location in relation to others and a heads-up display which shows the alerts.

Bayly M. et al (2006). Intelligent Transport Systems and motorcycle,p.30

Beneficiaries:

Monash University's Report on ITS and Motorcycle Safety states that inter-vehicle communication systems can potentially address a wide range of crash types, including intersection crashes, where driver inattention or visual obstruction is often factor. The system will be most effective if it is implemented in every vehicle since the success depends on the saturation of the system.

Figure 94: Possible information provided by an inter-vehicle communication system[89]

Clear definition of the problem

These systems maybe important for preventing the larger proportion of PTW-related multiple vehicle crashes occurring in urban areas, in particular crashes occurring at intersections where the visual conspicuity of riders and driver's inattention to approaching PTW are often factors.

Scientific background

Bayly et al (2007) noted that these systems require a large proportion of the vehicle fleet to have adapted this technology in order for it to have notable impact on crashes (see Report Lenné, Oxley, 2011)

Implementation

Trusting on the system:

- PTW rider demand for more scientific research and evaluation of the value and safety benefit of inter-vehicle communication systems.
- Riders demand systems which work well and they expressed clear concerns when it comes to relying on such systems (as technology is not yet developed enough).
- Riders require better description and information of how such systems operate (riders mentioned difficulties in assessing how such systems work exactly – which is a main reason for the low acceptance).

Legal situation:

- The question of who is held responsible in case the system fails or gives false information needs to be discussed (e.g. "Vienna convention on road traffic" - in the last resort the driver must be able to oversteer/overdrive his vehicle and must be able to interfere. For example in Germany[90] and Austria the regulatory law is valid which means that the responsibility for driving lies entirely with the driver). That is to say, when developing and implementing technical systems, legal situations need to be considered very carefully.
- Question of the transition period needs to be answered (will such systems have a road safety impact if just a small portion of the vehicle fleet has adapted this technology?)
- The question whether certain road users will be preferred (which can be located due to a transmitter) to others, need to be discussed and clarified.

Personal responsibility:

- Riders expressed a clear demand for the possibility of cancellation of functions of such systems in specific riding situations (e.g. when the motorcycle is in an inclined position, e.g. driving off at an intersection and getting on the right roadway. If the system detects an approaching vehicle and reduces the engine output, rider might fall into the curve).
- Inexperienced riders might panic if systems interferes in the riding task (e.g. all of a sudden brakes because for example a passenger is walking across the street) and run the risk of falling

[89] Source: Asanuma N. et al. (2000). Intelligent Technologies of ASV, p 8

[90] See homepage of the German Federal Ministry of Transport, Building and Urban Development: http://www.bmvbs.de/SharedDocs/DE/Artikel/StB-LA/fahrerassistenzsysteme-fas.html?view=renderDruckansicht&nn=36202

off the bike. The “human factor” is very unpredictable to a certain extend. Different people might react differently to such systems.

- Riders dislike the idea of compulsion. This was particularly mentioned with regard to Inter-Vehicle Communication Systems where they feel that they will take essential control away from them.
- The opinion was expressed that for an anticipatory driver there is no need for Inter-Vehicle Communication System and that much more emphasis must be put on the training of anticipatory riding styles instead of developing vehicle-to-vehicle technologies. In addition, the interviewed riders agreed on the fact that most motorcyclists know that their life depends on being careful (much more than for example when driving a car), on watching out carefully, on double-checking, etc. which corroborates the general critical attitude of PTW riders towards new technologies.

Costs:

- Many riders estimated these technologies as too expensive (especially for smaller motorcycles and scooters) and by far not ready for serial production.

Suggestions:

- Focus Group Interviewees suggested systems which provide only warnings as a possible compromise even though they experience permanent warnings or blinking lights as very stressful and distracting.

Acceptance

Acceptance by riders is generally very low.

Sustainability

Once in place and good order, these systems should sustainably avoid any collision to another vehicle equipped with a respective system. Effects in collisions to road users not equipped with such a system are widely unknown as well as effects of behavioural adaptation by riders.

Transferability

Once the technical solution is up and running, it is just a matter of investment to apply this in other places.

Costs and benefits

No information could be found particularly addressing this issue of PTW accidents.

Riders' perspective

★★★★★

The riders' associations support his measure insofar as the system in all vehicles is designed from the start to accommodate the needs, characteristics and vulnerabilities of PTWs. In particular, PTWs should not be ignored or missed by communication systems in other vehicles because it would lull drivers into a false sense of security.

Priorities

It is nice to believe that some when in the future, road vehicles will not have any collisions, because an on-board system automatically avoids them. There is still a long way to go until this becomes true.

18. Other Measures

Responsible Advertising Policy

Expert Assessment			
Overall		★★★☆☆	
Size	★★☆☆☆	Transferability	★★☆☆☆
Total impact	★★★★☆	Implementation	★★★★★
Safety impact	★★★★☆	Acceptance	★★★★★
Efficiency	★★★★☆	Sustainability	☆☆☆☆☆

Non-mission-critical roadside information, particularly on dangerous roads where margins for error are smaller, has the potential to distract a rider with a resultant threat to rider safety. A further threat to the PTW rider is the distraction caused to other road users whose distracted driving may produce unpredictable behaviour that may also threaten PTW rider safety.

Advertising in particular is designed to attract the attention of any passer-by whether as a pedestrian or using vehicular transport. A responsible advertising policy would consider the potential impact of its presence on those whose attention may be drawn by the advertising.

Communication and marketing can enhance safety-awareness, as they encourage safe and responsible behaviour and promote safety enhancing features such as advanced braking systems.

Example:

ACEM manufacturers have adopted a common Advertising Policy, which covers the following areas and entails the following actions:

- Safety-oriented PTW advertising content:

All riders and passengers shown in a riding position shall always wear a certified helmet and be shown in compliance with the relevant road safety regulations. All promotion and advertisements, where deemed appropriate, shall show an insignia or a message denoting a helmet and a text recommending riders to ride responsibly and wear a certified helmet (e.g.: “ride safely, wear a helmet”). When appropriate the advertisement shall indicate that the pictures have been shot on a circuit/closed road with a professional rider.

- Promotion of safety-enhancing features:

Manufacturers shall include in any promotion and advertisement details of any safety-enhancing features of the advertised PTW.

- Promotion of dealer training programmes:

Manufacturers acknowledge the need for joint development and promotion of dealer training programmes on the Promotion & Advertising guidelines. Manufacturers shall include in any dealer training details of any safety-enhancing features of their PTWs with the corresponding promotional material.

- Media information:

Manufacturers shall inform the Media about and supply them with the ACEM Promotion and Advertising guidelines, with respect to the on-road testing of PTWs.

http://www.acem.eu/cms/advertguidelines.php

There is a whole culture of road behaviour which is fuelled by magazines advertising specific types of motorcycles, clothes, etc. It may be the case that riders who take “risks” is due to the marketing strategies of the motorcycle industry, with sales videos and websites that encourage riders to do dangerous stunts. Advertising is important for the whole motorcycle industry and their products require an emotional acceptance by consumers.

Besides, motorcycle magazines are an important commercial part of motorcycling and cover issues from classic motorcycles, racing, maintenance, owner groups and so forth. However, some motorcycle magazines give messages that are overtly irresponsible: features relating to reckless riding on the back wheel as well as encouraging high speeds on public roads. Unfortunately, there are riders who follow the “advice” of these magazines who actually believe that they are gaining skills to ride more proficiently.

http://www.righttoride.co.uk/virtuallibrary/riskandmotorcycling/RISK_AND_MOTORCYCLING_161109v3.pdf

Beneficiaries:

If all promotion and advertisements show PTWs used in a safe and responsible manner, this will positively influence the attitude of the user.

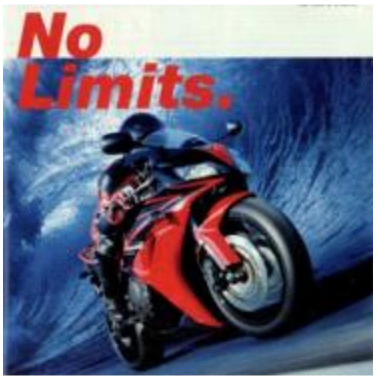

Figure 95: Example of an irresponsible advertisement[91]

Clear definition of the problem

Advertisement for PTW, which glorifies "speed", "power" or similar categories may motive certain groups of riders to reckless behaviour.

Size of the problem, Expected impact

No information could be found to which extent irresponsible advertisement can motivate riders to reckless riding an to which extent responsible advertising may change the situation.

Scientific Background

According to Germs-Homolava (1995), advertisements sometimes provoke dangerous behaviour. Advertising aims at raising interest and promotes building of certain attitudes, which on the liong run influences behaviour.

Implementation, Acceptance, Transferability

The example described above show that the motorcycle industry has a strong interest in responsible advertising. A commitment like this can be implemented anywhere. Implementing responsible advertising by other means than commitment by the industry seems out of scope.

Sustainability

A responsible advertising policy by an association of manufacturers and dealers might be undermined by manufacturers or dealers not being members of this association, or even by member of such organisations, who are not willing to follow a common policy.

Costs and benefits

It may be assumed that responsible advertising does not induce any cost. However, there might be negative benefits in advertising of certain groups of vehicles, where designated purchasers might be sensitive to advertising by attributes like "speed" or "power".

Riders' perspective

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[91] Source: FEMA (2007) A European Agenda for Motorcycle Safety, p.57

★★★★☆

The riders' associations strongly support this measure, because it increases awareness of good practices among riders and avoids creating unrealistic expectations in novice riders.

Priorities

The group or riders being sensitive to sensation-seeking advertisement may be rather small. Such an assumption by the experts would explain the low rating to "Size of the Problem". It may be assumed that the positive effects of years of responsible advertising can easily be destroyed by a single irresponsible campaign. Maybe the experts have also taken into account the limited power of industry associations in enforcing voluntary agreements of their members.

Measurement of Road Operating Ability of Pure Electric Vehicles

Expert Assessment			
Overall		★★☆☆☆	
Size	☆☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	★★★☆☆	Implementation	★★☆☆☆
Safety impact	★☆☆☆☆	Acceptance	★★★★☆
Efficiency	★★★☆☆	Sustainability	★★★★☆

New engines that work on an electrical basis have been developed for several years. As first models are available for PTW riders, regulations have to be established that seize the safe functioning of such vehicles. Guidelines are published which contain recommendations for the measurement of the road operating ability of pure electric vehicles.

Example:

In Germany, the guideline “Electrically propelled road vehicles - Measurement of road operating ability - Part 1: Pure electric vehicles; German version - DIN EN 1821-1” was implemented in 1998 which regulates the technical requirements of this class of vehicles.

http://germany.ihs.com/collections/din/esden.htm

Beneficiaries:

The guideline addresses the vehicle categories motorcycle and moped as well as E-Bikes and it is targeted on the technical requirements.

Clear definition of the problem

The missing engine sound of pure electric vehicles/PTWs is causing potential safety deficiencies. Much more dangerous than not being recognized (PTWs with legal exhaust systems are already very quiet) due to the missing engine sound, is the missing feedback (also low vibration level) of the actual speed or acceleration status to the rider. The wrong interpretation of the vehicle speed/vehicle dynamics is the main risk for electric PTW conflicts.

Size of the problem, Scientific Background, Expected Impact(s), Implementation, Acceptance

Not known at the moment. Ongoing research is about understanding the size of the problem, potential countermeasures and their effects. As soon as there is sufficient scientific evidence, issues of implementation can be assessed.

Sustainability, Transferability, Costs and benefits

Will depend on the results of ongoing research and the measures that are proposed.

Riders' perspective

★★☆☆☆

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

Currently, all over the world research is executed to determine future effect of e-mobility. This is not limited to PTW, but electric bicycles and PTW are considered within some of these initiatives. Hence, priority should be put on research activities.

Measurement of Road Energy Performance of Thermal Electric Hybrid Vehicles

Expert Assessment			
Overall		☆☆☆☆☆	
Size	☆☆☆☆☆	Transferability	☆☆☆☆☆
Total impact	☆☆☆☆☆	Implementation	★☆☆☆☆
Safety impact	☆☆☆☆☆	Acceptance	★★★☆☆
Efficiency	☆☆☆☆☆	Sustainability	★☆☆☆☆

Thermal electric hybrid vehicles have been developed as an alternative to common combustion engines. As first models are available, regulations concerning the energy performance of such vehicles need to be established. Guidelines are published which contain recommendations for the measurement of the energy performance of thermal electric hybrid vehicles.

Example:

In Germany the guideline “Electrically propelled road vehicles - Measurement of energy performance - Part 2: Thermal electric hybrid vehicles; German version - DIN EN 1821-2” was implemented in 2003 which regulates the technical requirements of this certain class of vehicles.

http://germany.ihs.com/collections/din/esden.htm

Beneficiaries:

The guideline addresses the vehicle categories motorcycle and moped and is targeted on the technical requirements.

Clear definition of the problem

As long as there is no clear instruction how to measure the road energy performance of thermal electric hybrid vehicles neither the public authorities (with respect to administrative issues) nor potential customers (with respect to environmental issues) can receive comparable technical information from manufacturers.

Size of the problem

The size of this problem cannot be estimated.

Expected impact

This measure will have an impact mainly on environment.

Potential buyers of thermal electric hybrid vehicles will be safe in the knowledge that the vehicle is fulfils the requirements concerning emissions and environmental data as specified by the manufacturer. Due to that fact, even more road users could eventually buy such a vehicle. Besides, such a measure will have an impact on public authorities: This way, it will be easy to determine how the vehicles fit into the legal system of a country. The police will also benefit from this measure as they will have instructions how to check thermal electric hybrid vehicles with respect to their road energy performance in the course of roadside testing. If the measurement of the road energy performance of thermal electric hybrid vehicles will become mandatory with respect to the type approval, manufacturers of these vehicles will also gain benefit of this measure as it will lead to a harmonization of the European automotive market.

Implementation

UN ECE Regulation R101 contains such a standard, which could be applied worldwide.

Acceptance

It is unlikely that this measure is not accepted because testing standards are normally developed by the industry as well as public authorities.

The general public is not affected by this measure.

Sustainability

Fading of effects cannot be expected. This measure intends to improve sustainability.

Transferability

UN ECE Regulation R101 could be applied worldwide.

Costs and benefits

The costs of such a performance measurement can easily be quantified, but there is no data about the benefit.

Riders' perspective

★★★★★

The riders' associations support this measure because it ensures products offered for sale meet minimum requirements for quality and safety.

Priorities

This measure is an issue of fair competition on a market, which currently hardly exists. It does not affect road safety at all, which may be a reason for low appreciation by experts, who are mainly road safety experts.

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Annex 1: Template for star rating questionnaire

Q 0) Which groups of stakeholder do you belong to? *(Multiple Choice= MC)*

- Riders
- Other road users
- Science
- Industry
- Education (schools, driving schools, etc)
- Infrastructure provider
- Legislative bodies (i.e. politicians, public administration)

Q 1) To which extent do you consider yourself an expert for this measure? *(Single Choice= SC)*

- 5 – I'm well informed about the issue
- 0 – I'm no expert at all

Q 2) What is the size of the problem that is addressed by this measure? *(SC)*

- 5 – One of the key safety problems of PTW use
- 0 – There's no real problem to solve

Q 3) Please rate the following aspects of the measure: *(SC, from 5 – very positive to 0 – very negative)*

- Impact on safety
- Impact on accessibility of PTW as a means of transport
- Impact on travel times
- Impact on users of other vehicles
- Relation between the expenditure and the macro-economic benefits

Q 4) Where do you think this measure can be implemented successfully? *(SC)*

- 5 – globally
- 4 – in most European Countries (beyond EU)
- 3 – in the vast majority of EU Member States
- 2 – in selected EU regions (e.g. Northern Europe, southern European countries)
- 1 – in emerging economies
- 0 – only in a very limited area

Q 5) Please rate the following statements: *(SC, from 5 – strongly agree to 0 – strongly disagree)*

- The implementation of this measure is very easy.
- The measure can be implemented immediately.

Q 6) What are the most critical issues with the implementation of this measure? (*MC)*

- technical
- legal
- economic
- societal
- ecological
- political
- none

Q 7) With respect to this measure, to which extent will be the acceptance of... *(SC, from 5 – will fully accept it to 0 – not at all)*

- PTW riders?
- Other road users?

Q 8) Which groups would you expect to oppose the implementation of this measure? (*MC)*

- Riders
- Other road users
- Scientists
- Industry
- Education (schools, driving schools, etc)
- Infrastructure providers
- None

Q 9) Will effects of this measure fade (e.g. behavioural adaption, risk compensation, people forget about educational measures,…)? *(SC)*

- 5 – not at all
- 0 – quickly

Q 10) What safety impact do you expect? (*MC)*

- No impact at all
- Mitigation of property damage
- Reduction of property damage only crashes
- Reduction of crash severity
- Saving of lives
- Prevention of all kinds of crashes

Q 11) Please rate the following statements: *(SC, from 5 – strongly agree to 0 – strongly disagree)*

- Very high priority should be given to the implementation of this measure in the EU Member States.
- This measure fits my idea of Best Practice perfectly.

Annex 2: Template for data collection

Short Description of the measure

- Describe the measure in a sentence or two

Clear definition of the problem

- What is the particular problem of a PTW rider that is solved/addressed by this measure? e.g. "PTW riders exceeding the speed limit"

Size of the problem

- What is the size of the problem that is addressed by this measure? Eg "speed is estimated to be a contributing factor in X% of motorcycle crashes in Europe (ref)"

Scientific Background

- Is there scientific evidence to support the implementation of this measure? If yes, what is it?
- Why and how do we believe that this measure works?
- To what extent does the measure directly target the identified problem?

Implementation

- What are the barriers to implementation of this measure?
- What are critical issues to be considered in implementing it?
- What are things to avoid in implementing this measure?
- How can awareness of the measure be raised?

Expected Impact(s)

- In what area (s) will this measure have an impact? Eg safety, mobility, environment, other?
- What impact will the measure have? Eg "it will reduce motorcycle rider fatalities in Europe by 10% per annum; it will make riders more conspicuous etc"
- Are there evaluations done in 2BESAFE that provide evidence of the impact of this measure? What are the results?
- What would be a measure of success for this measure? How would we know it is working well?
- Are any side effects likely? e.g. Risk compensation

Acceptance

- Acceptance by riders?
- Acceptance by other road users?
- Acceptance by industry?
- Acceptance by educational bodies (schools, driving schools, etc)?
- Acceptance by infrastructure providers?
- Acceptance by legislative bodies (i.e. politicians, public administration)?
- How can we deal with measures that are not accepted because those concerned do not consider the problem to be a problem (for each of the groups mentioned above)?
- How can we deal with measures, which are dedicated to solve a particular problem, but the public does not consider the measure to be effective (for each of the groups mentioned above)?

Sustainability

- Do we believe there is a risk of fading of effects? Why? e.g.:
- Fading of the measure itself, like for campaigns or educational measures: ie people forget about it.

- Fading of systems: behavioural adaptation to new measures
- Consider also risk compensation and similar effects, but from the practical point of view.

Transferability

- Is implementation of the measure possible somewhere else than described in the example(s) above?
- Is implementation possible in Europe (if example is from another continent)?
- Do you expect the measure to have different impacts in different countries within Europe (e.g. north vs. south)

Costs and benefits

- What, if any, data exists on the costs and benefits of this measure?

Priority

- What priority should be given to implementation of this measure in EU countries?

List of Abbreviations

2-BE-SAFE	2-Wheeler Behaviour and Safety
AASHTO	American Association of State Highway and Transportation Officials
ABS	Anti-Lock Braking Systems
ACC	Adaptive Cruise Control
ACEM	Association des Constructeurs Européens de Motocycles
ACPO	Association of Chief Police Officers
ACU	Auto-Cycle Union
ADAC	Allgemeiner Deutschter Automobil-Club e.V. (General German Automobile Association)
ADAS	Advanced Driver Assistance System
ADR	Australian Design Rule
AHO	Automatic Headlamps On
AIB	(Danish Road Traffic) Accident Investigation Board
APROSYS	Advanced Protective Systems
ARAS	Advanced Rider Assistance System
ASC	Automatic Stability Control
ATC	Australian Transport Council
BAC	Blood Alcohol Content
bfu	Beratungsstelle für Unfallverhütung (Swiss Council for Accident Prevention)
BMVIT	Bundesministerium für Verkehr, Innovation und Technologie (Federal Ministry for Transport, Innovation and Technology)
BPC	Brussels Programme Centre
BS	British Standard
CBS	Combined Braking Systems
CBT	Compulsory Basic Training
CDV	Centrum Dopravního Vyzkumu (Transport Research Centre)
CEN	Committee of European Normalisation
DfT	Department for Transport
DIN	Deutsches Institut für Normung e. V. (German Institute for Standardisation)
DOT	Department of Transportation
DRL	Daytime Running Lights
DTC	Dynamic Test Center
DUII	Driving Under the Influence of Intoxicants

DVR	Deutscher Verkehrssicherheitsrat e.V. (German Road Safety Council)
EAMS	European Agenda for Motorcycle Safety
EC	European Commission
eCall	Emergency Call
ECE	Economic Community of Europe
ECMT	European Conference of Ministers of Transport
ECU	Electronic Control Unit
EEC	European Economic Community
EMS	Emergency Medical Service
EN	European Normative
ERF	European Union Road Federation
eSUM	European Safer Urban Motorcycling
ESV	Enhanced Safety of Vehicles
ETSC	European Transport Safety Council
EU	European Union
Euro NCAP	European New Car Assessment Programme
EuroRAP	European Road Assessment Programme
FAME	Fondation Avancé des Motards Européens
FEMA	Federation of European Motorcyclists Associations
FGSV	Forschungsgesellschaft für Straßen- und Verkehrswesen (German Road and Transportation Research Association)
FMVSS	Federal Motor Vehicle Safety Standard
FOT	Field Operational Test
FSG	Führerscheingesetz (Austrian Driving License Law)
FSV	Österreichische Forschungsgesellschaft Straße – Schiene – Verkehr (Austrian Association for Research on Road – Rail – Transport)
GDV	Gesamtverband der Deutschen Versicherungswirtschaft e.V (German Insurance Association)
GLS	Graduated Licensing System
GPS	Global Positioning System
gTKP	Global Transport Knowledge Partnership
ICT	Information and Communication Technology
ifz	Institut für Zweiradsicherheit (Institute for Motorcycle Safety)
IHIE	Institute of Highway Incorporated Engineers
iRAP	International Road Assessment Programme
IRF	International Road Federation

ISA	Intelligent Speed Adaption
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
IVIS	In-Vehicle Information System
KFG	Kraftfahrgesetz (Austrian Motor Vehicle Law)
KfV	Kuratorium für Verkehrssicherheit (Austrian Road Safety Board)
LAMS	Learner Approved Motorcycle Scheme
MAIDS	Motorcycle Accident In-Depth Study
MMUCC	Model Minimum Uniform Crash Criteria
MOT	Ministry of Transport
MPE	Multiphase Education
MSF	Motorcycle Safety Foundation
NCHRP	National Cooperative Highway Research Program
NDORS	National Driver Offender Retraining Scheme
NGO	Non-Governmental Organization
NHTSA	National Highway Traffic Safety Administration
NMC	National Motorcycle Council
OBIS	On-Bike Information System
OECD	Organization for Economic Co-operation and Development
PIRE	Pacific Institute for Research and Evaluation
PISa	PTW Integrated Safety
PPE	Personal Protective Equipment
PTW	Powered Two Wheeler
RiZA	Risk Zones Application
RSA	Road Safety Audit
RSI	Road Safety Inspection
RVS	Richtlinien und Vorschriften für das Straßenwesen (Guidelines and Specifications for Roads)
SIM	Safety in Motion
StVO	Straßenverkehrsordnung (Austrian Road Traffic Act)
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAC	Transport Accident Commission
TEN	Trans-European Network
TRB	Transportation Research Board
TRL	Transport Research Laboratory

VDOT	Virginia Department of Transportation
VMAC	Victorian Motorcycle Advisory Council
VRU	Vulnerable Road User
Vs.	Versus
VTTI	Virginia Tech Transportation Institute
WP	Work Package

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