### D6.1.2 Dissemination Conference Proceedings

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<td>M. Sotola</td>
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<td>I. Ducci, M. Pieve</td>
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*Project co-funded by the European Commission - DG RTD in the 6th Framework Programme*
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<td>Anti-lock Brake System</td>
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<td>ACEM</td>
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<td>ERTRAC</td>
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<td>Enhanced Safety of Vehicles</td>
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Executive summary

This deliverable describes all the dissemination events in which Piaggio and other partners participated during the 3 years of project.

The list of all the events in which SIM Project partners participated or are going to participate in 2010, is shown.

The description of the items is accompanied by abstracts, full papers and posters as well.
1. Dissemination Events in the Past

1.1 Transport Research Arena Europe 2006
12 – 15/06/2006 Göteborg (Sweden)
SIM project was hosted at the European Commission Stand in the area of Safer Road Transport. The concept of the project was presented by showing a poster with a general description of the objectives and a Piaggio MP3 scooter, selected as vehicle platform for SIM prototype. Project proposal was approved but not yet started.

Presentation of SIM project – TRA Conference 2006

1.2 20 ESV Conference 2007
18 – 21/06/2007 Lyon (France)
20th Enhanced Safety of Vehicles Conference Lyon

This conference is a premier event in the field of motor vehicle safety research. The ESV Program originated more than three decades ago under the North Atlantic Treaty Organization (NATO) Committee on the Challenges of Modern Society, and was implemented through bilateral agreements between the Governments of the United States, France, the Federal Republic of Germany, Italy, the United Kingdom, Japan, and Sweden. The participating nations agreed to develop experimental safety vehicles to advance the state-of-the-art technology in automotive engineering and to meet periodically to exchange information on their progress.
The following paper about SIM project overview was submitted and selected for oral presentation during the conference (Annex I).

The abstract is reported below.

**SIM PROJECT: A WAY FOR PTW INTEGRATED SAFETY**

Federico Galliano  
Mario Donato Santucci (Co-Author)  
Piaggio & C. SpA  
Italy

Oliver Hoffmann (Co-Author)  
Continental Teves AG&Co. oHG  
Germany

Begoña Pérez-Magallón  
CIDAUT  
Spain

Massimo Guiggiani  
University of Pisa  
Department of Mechanical, Nuclear and Production Engineering  
Italy

Paper Number 07-0080

**ABSTRACT**

The paper will describe the features and characteristics of the project SIM (Safety In Motion). SIM Project is aimed at carrying out R&D activities addressing in-depth studies of a suitable and comprehensive safety strategy for powered-two-wheel (PTW) vehicles, in order to avoid road accidents and/or mitigate their consequences.

Main objectives of SIM are:

− to identify a suitable safety strategy for PTWs;
− to enhance preventive and active safety acting on electronic vehicle management and improving Human-Machine-Interaction (HMI);
− to focus on integral passive safety devices;

An integrated approach to the complex concept of motorcycle safety shall establish a matrix relationship between the three main factors or pillars for safety (PTW, rider and infrastructure) and the different aspects related to accident dynamics, from before-precipitating event to crash event (dealing with preventive, active and passive safety). The research will be based on the analysis of motorcycle accident databases from MAIDS, GIDAS and DEKRA. According to that, SIM project focuses on the vehicle safety aspects, including the human-machine-interaction.

Main results expected are:

− development of electronic active devices (e.g. enhanced anti-lock braking system, traction control and brake-by-wire) for powered two-wheelers;
− development of a passive safety algorithm to activate passive safety devices;
- adaptation of protective inflatable devices located on the rider (garment) and on the vehicle (for lower limbs)
- implementation of innovative HMI

On-road and laboratory tests, based on the most relevant accident scenarios, will be conducted in order to evaluate the effectiveness of the safety system devices (e.g. mitigation of injuries via inflatable devices, probability of avoiding accident, etc...) fitted on an integrated concept vehicle. Innovation aspects are mainly an integrated approach to the issue and the introduction of new safety technologies in PTW field.

1.3 Motocykl 2008

05-09/03/2008 Prague (Czech Republic)

MOTOCYKL exhibition marks the beginning of motorcycle season. Each year thousands of visitors from the whole Czech Republic and abroad come to visit the show. The exhibition is included in the European calendar of exhibitions and fairs of ACEM.

SIM Project poster was situated in exhibition statue of Czech Technical University, which was mainly aimed to motorcycle safety. Visit rate was approximately 60 thousands visitors.

Figure 1 Poster at Czech motorcycle exhibition
1.4  Transport Research Arena Europe 2008
21-25/04/2008 Ljubljana (Slovenia)

The TRA contributes to innovation for sustainable mobility in Europe, leading to a greener, safer and smarter transport system, which will be more sustainable, competitive and efficient. By enhancing the networking and clustering of Europe’s research and development capacity – based on a shared Strategic Research Agenda (SRA) and Research Framework – the TRA helps to align European, national, regional and private research and development actions on transport.

SIM preliminary prototype equipped with a deployed airbag was exhibited at the stand of the European Commission and a presentation of the project was given during the press conference (Annex 2).

1.5  Small Engine Technology Conference
09-11/09/2008 Milwaukee (Wisconsin USA)

Since its first event in 1989, the Small Engine Technology Conference (SETC) continues to be the international technology conference for small engines and related products. SETC is jointly sponsored each year by the Society of Automotive Engineers of Japan, Inc. (JSAE) and SAE International.

Two papers have been submitted and accepted and are presented below.

1.5.1 Comparison Between Experimental and Numerical Handling Tests for a Three-Wheeled Motorcycle

Francesco Frendo
R. Bartolozzi
Massimo Guiggiani
Univ. of Pisa
Italy
O. Di Tanna
Piaggio & C. S.p.A
Italy

Document Number 2008-32-0061

ABSTRACT

This paper deals with the analysis of the handling behaviour of a novel three-wheeled motorcycle. This vehicle has two front steering wheels and a single rear wheel and can be driven much like a common two wheeler.

In order to analyze the handling behaviour of such vehicle and to compare it to an ordinary two wheeler, an experimental campaign was conducted with the vehicle endowed with several transducers. Experimental tests included some classical handling manoeuvres. Concurrently, a simulation model was developed using a multi-body code. A simple logic was employed to drive the model; it consists in a roll follower and a longitudinal velocity follower.

The main dynamic parameters obtained from simulations, such as the steering angle and steering torque are compared to the experimental data and discussed. The effect of the driving style on the manoeuvre is also analyzed with reference to steering pad manoeuvres.
1.5.2 Stability Analysis Of A Three-Wheeled Motorcycle

Antonio Sponziello
Francesco Frendo
Massimo Guiggiani
Univ. of Pisa
Italy

Document Number 2008-32-0062

ABSTRACT

In this work the modal analysis of a three-wheeled tilting motorcycle is presented. This new kind of vehicle has two front wheels and a single rear wheel, but is driven like a common motorcycle.

In order to study the stability of the system in straight running, two models have been developed: a simplified motorcycle model, with locked suspensions and rigid and thin tires and a more accurate model having 14 degrees of freedom, in which the stiffness and damping of suspensions and the radial stiffness of tires have been taken into account. In both models the frame has been considered as rigid and the driver was assumed to be fixed to the frame. A linear model with transient behaviour has been employed for describing the tire behaviour.

A reference model of a two wheeler with similar inertial properties has been also developed for comparison.

1.6 5th ACEM Annual Conference
01/12/2008 Brussels (Belgium)

At its 5th Annual Conference, ACEM outlined the industry strategy for shaping this future in cooperation with policymakers and other stakeholders. ACEM members at the forefront in powered two-wheeler innovation also showcased their initiatives in the exhibition area during the walking lunch and at the end of the conference.

SIM poster has been presented.
In this 1-day Workshop, all the results achieved in APROSYS SP4 were presented with an integral approach. The different developments such as the protective equipment (helmet and thorax protector prototypes), new motorcyclist protective device (infrastructure), activation strategies for firing the passive safety device, ... Validation tests for helmet and thorax protector were also demonstrated together with a couple of crash tests both against car and against infrastructure (according to the standard proposal).

A presentation about the status of SIM activities and partial results was shown (Annex 3)

1.8 APROSYS SP4 Final Event
17-18/02/2009 Amsterdam (The Netherlands)

The APROSYS Final Event has taken place on the 17th and 18th of February 2009. The results of the project have been demonstrated and presented. On the first day the main conclusions of the project have been shown. A first panel session was set up to discuss how the APROSYS results can be implemented to address the challenges articulated by the EU and industry. On the second day two parallel interactive workshop sessions were organised focussing on how the new technologies and methods developed in the APROSYS Project can be used to influence and improve the protection of all road users. Regulatory,
infrastructural, technical and commercial aspects were also investigated. The process after the White Paper on European transport policy for 2010 has been addressed.

SIM has been invited to exhibit the cooperation with APROSYS SP4 project (Motorcycle Accidents). One poster, one video about SIM Project and vehicle prototype equipped with crash sensors and datalogger (on behalf of APROSYS) as well as a deployed airbag fitted on the vehicle were shown.

![Figure 3 SIM – APROSYS cooperation poster](image)

![Figure 4 Vehicle prototype and video at APROSYS final event](image)
1.9 21 ESV Conference 2009
15-18/06/2009 Stuttgart (Germany)
21st Enhanced Safety of Vehicles Conference Stuttgart

The ESV Program originated more than three decades ago under the North Atlantic Treaty Organization (NATO) Committee on the Challenges of Modern Society, and was implemented through bilateral agreements between the Governments of the United States, France, the Federal Republic of Germany, Italy, the United Kingdom, Japan, and Sweden. The participating nations agreed to develop experimental safety vehicles to advance the state-of-the-art technology in automotive engineering and to meet periodically to exchange information on their progress.

Two papers have been submitted and selected for oral presentation.

1.9.1 Powered Two Wheelers Integrated Safety – First Results Of The Sim Project

Mario Donato, Santucci
Marco, Pieve
Piaggio & C. SpA
Italy
Jens, König
DEKRA Automobil GmbH
Germany
Elena, Bianco
Centro Ricerche Fiat
Italy
Jesús, Vázquez de Prada Martinez
CIDAUT
Spain

Paper Number 09-0283

ABSTRACT

First outcomes of activities carried out in Safety In Motion EU project are described. SIM Project is aimed at identifying a suitable and comprehensive safety strategy for powered-two-wheel (PTW) vehicles, in order to avoid road accidents and/or mitigate their consequences. Starting from the outcomes of previous accidentology activities an in-depth analysis was conducted focusing on the scenarios identified as the most frequent and dangerous for PTWs accidents. Significant accident parameters were identified and related values were analyzed. Also a technology evaluation based on state-of-the-art analysis as well as partners expertise was conducted and the effectiveness of potential benefits of safety systems was evaluated in reconstructed accident scenarios. On such a basis a PTW safety strategy has been identified in all safety areas. The active safety improvement is reached by actively controlling PTW stability and improving riding comfort (advanced braking and suspension systems). In preventive safety area an HMI Information Management concept for motorbike was identified as the most effective solution for enhancing the PTW rider’s awareness. Focusing on passive safety aspects, a frontal airbag fitted on motorcycle (aiming at protecting rider against the primary impact) and an inflatable wearable device (mainly for secondary impact) have been chosen to be tested either separately and jointly. The following safety devices have been finally selected in order to be implemented and tested on vehicle prototypes:

This project has been co-funded by the European Commission DG-RTD in the 6th Framework Programme. The content of this publication is the sole responsibility of the project partners listed herein and does not necessarily represent the view of the European Commission or its services.
Active Brake System
- Stability management by traction control
- Semi-Active Suspension System
- Frontal airbag
- Inflatable wearable device
- HMI Information management concept for motorBikes (IMB)
- Enhanced HMI (ergonomic handlebar controls, wireless communication, Head-Up Display)

An integral approach to PTW safety enhancement was adopted, since all the safety devices will be implemented and tested on the same vehicle platform, the innovative PTW tilting three-wheelers Piaggio MP3.

1.9.2 Effectiveness Evaluation Of Antilock Brake Systems (Abs) For Motorcycles In Real-World Accident Scenarios

Dr. Georg Roll
Oliver Hoffmann
Continental AG, Division Chassis & Safety
Germany
Jens König
DEKRA Automobil GmbH
Germany

Paper Number 09-0254

ABSTRACT

Although motorcycle ABS is meanwhile well established on the public market, detailed investigations about the relationship between crash scenarios and the effectiveness of motorcycle-ABS are rare. Within the EC-funded SIM Project (Safety In Motion) a detailed analysis of different accident scenarios with PTWs (Powered Two Wheelers) has been performed, using the DEKRA PTW-database. The basis of this data pool is the accumulation of written expert opinions containing the accident analyses that are drawn up by skilled forensic experts throughout Germany. From this database containing 350 real-world accidents, 51 cases have been selected by imposing a reaction demand and a following braking of the motorcycle rider in order to evaluate the benefit of advanced brake control systems. The following parameters have been extracted for the evaluation:

- Collision speed and initial speed
- Distance of falling location to collision point
- Braking distance
- Median braking deceleration
- Starting point of breaking
- Reaction point/demand
- Kind of reaction
- Road surface
- Weather

With this information several real accident scenarios without ABS were analysed under the condition that an ABS system would have been installed on the motorbike. With such an approach the difference in the accident consequences with and without ABS can be observed. In addition a variation in the ABS control has
been accomplished by considering different brake control systems developed by CONTI, like partial and full integral brake systems as well as systems with advanced driver-assistance functions (ADAS). As a result, a tremendous reduction in the accident consequences can be shown, for example up to 50% of the selected accidents could have been avoided by a simple 2 channel ABS.

1.10 **International Motorcycle Symposium 2009**

21-22/09/2009 Berlin (Germany)

The International Motorcycle Symposium is promoted by the German Insurers Accident Research (UDV) and the German Road Safety Council to address the issue of motorcycle safety. In Europe, a motorcyclist’s risk to be killed in a road accident is eighteen times that of a car driver. Motorcyclists account for 16% of all deaths on the road although they make up only 2% of all road users.

Piaggio was invited to present a concrete solution for improving urban mobility and the Piaggio MP3 peculiarities was presented together with the advances achieved within SIM project. (Annex 4).

1.11 **16th ITS Intelligent Transport Systems 2009**

21-25/09/2009 Stockholm (Sweden)

The ITS World Congress in 2009 is a unique occasion to demonstrate the expertise and high standard of achievement within the field of ITS. This annual event rotates between Europe, the Americas and Asia-Pacific region and comes to Sweden for the first time in 2009. The international ITS community participated in this prestigious event in significant numbers with opportunities to take part as a delegate, speaker, exhibitor and visitor.

At ITS Stockholm SIM project has been hosted at EC stand in the exhibition area of Safe Mobility. A SIM vehicle prototype was shown, equipped with all active safety features (stability management system, semi-active suspension system) and with HMI components.

A leaflet about the project was disseminated.

![Figure 5 SIM prototype at ITS 2009](image-url)
This project has been co-funded by the European Commission DG-RTD in the 6th Framework Programme. The content of this publication is the sole responsibility of the project partners listed herein and does not necessarily represent the view of the European Commission or its services.
1.12 Driver Car Interaction and Interface 2009
02-03/11/2009 Prague (Czech Republic)

The aim of this conference was to continue on discussion on the theme of safety and reliability of driving
and all the problems connected to this topic. It covered subjects which are partially sub/problems of the
Human Machine Interaction discipline and on the other hand showed results from very distant disciplines.
Interactive Simulation Workshop was held in second day of the conference. DCI (driver to car interaction)
gathers under one roof the results of the research in many scientific and industrial branches, like safety,
transportation, industrial design, medicine or psychology. The conference was open to participants coming
from areas of basic and/or applied research, car industries, design and ergonomics, medical research etc.

An abstract and a paper were submitted and accepted, a presentation about activities carried out on rider
comfort within SIM Project was done.

MOTORCYCLISTS´ COMFORT OPTIMISATION BASED ON SITTING GEOMETRY

Martin Sotola
David Fischer
Petr Chotebor
CTU in Prague, FTS
Czech

ABSTRACT

A purpose of this study is to determine a sitting geometry influence on drivers´ comfort. Sitting geometry is
simply defined by two triangles. The places of contacts between motorcycle and driver are seat, steering
handlebars and footrests. It has been prepared a methodology for measuring of the triangles and database
with measured values of many marques and types of motorcycles.

A motorcycle sitting simulator operation ranges have been determined and simulator has been designed
and built with Safety in Motion Project support (European Commission - DG RTD in the 6th FP). It is possible
to set most of the drivers´ sitting positions and partially simulate acceleration and deceleration on simulator.

The simulator has been set to the sitting positions for scooter, enduro, super-sport and chopper. An
evaluation of comfort has been in a first approach performed based on the subjective tiredness feeling of
motorcycle drivers sitting on the simulator. Every motorcycle type is specified by many parameters and sitting
position is one of them. Its effect on active and passive safety is examined.
2. The List of Planned Dissemination Activities

2.1 Transport Research Arena Europe 2010
07-10/06/2010 Brussels (Belgium)

TRA 2010 is an event for the alignment of the stakeholders of transport research and development. It follows previous successful editions of the conference in 2006 in Gothenburg, and in 2008 in Ljubljana. The TRA contributes to innovation for sustainable mobility in Europe, leading to a greener, safer and smarter transport system, which will be more sustainable, competitive and efficient. The European Commission welcomes this TRA and strongly supports it as an opportunity for all parties involved to meet and to present, exchange and disseminate the results obtained in research and development.

The following abstract has been submitted and accepted. A paper was also submitted and accepted for oral presentation.

MAIN RESULTS OF SAFETY IN MOTION PROJECT: A CONCRETE CONTRIBUTION TO PTW SAFETY

Mario Donato Santucci
Marco Pieve
Piaggio & C. SpA
Italy
Elena Bianco
Centro Ricerche Fiat
Italy
Jens Koenig
DEKRA
Germany
Jesús Vazquez de Prada
CIDAUT
Spain

ABSTRACT

Within this paper the main results of activities carried out in Safety In Motion (SIM) EC project are presented. SIM Project is aimed at identifying a suitable and integrated safety strategy for Powered-Two-Wheel (PTW) vehicles, in order to avoid road accidents or mitigate their consequences.

The main tangible results are:
- two vehicle prototypes equipped with the most relevant safety systems
- the measurement and comparison of their performances through on road tests and crash tests.

PTW safety strategy has been identified for all safety areas (active, preventive and passive) on the basis of the results of previous accidentology studies (e.g. APROSYS project) and by an in-depth analysis on accident scenarios aimed to evaluate the effectiveness of most promising safety systems applicable to PTWs.

The following safety devices have been implemented in the same vehicle platform:
- Active Brake System;
- Stability management by traction control;
- Semi-Active Suspension System;
- Frontal airbag;
- Inflatable wearable device;
In the area of active safety, comprehensive tests have been conducted on SIM prototypes for evaluating the enhancement of active safety level in terms of handling and stability control, both in laboratory and on road. Comparative tests have been conducted on SIM prototypes for evaluating the enhancement of active safety level in terms of handling and stability control, both in laboratory and on road.

Concerning passive safety, a frontal airbag fitted on PTW (protection against primary impact) and an inflatable wearable device (mainly for the secondary impact) have been implemented while an activation algorithm has been developed.

Their effectiveness has been measured through sled tests and full scale crashes in selected configuration. The reduction of dummy injuries has been compared within the same configurations with and without safety devices.

Topic: Safety and Security – Passive and Active Safety Systems or Vulnerable Road Users

2.2 International Conference Safety and Mobility of Vulnerable Road Users

30/05/2010 Jerusalem (Israel)

The changing trends in personal transportation, environmental concerns, quality of life, and safety are all converging on a worldwide increase in walking, cycling, and motorcycling as means of transportation. The increasing exposure of motorcyclists, bicyclists, and pedestrians (i.e., vulnerable road users; VRUs) to road traffic raises the concern for the safety of the VRU.

The goal of this conference is to bring together the latest scientific information, best practices, and policies from different countries with different cultures and experiences. The conference will focus on research, countermeasures, and programmatic implementation. The conference will include plenary talks by international experts, oral presentations of papers, poster sessions, workshops, panel discussions, and professional tours.

An abstract has been submitted and accepted. Paper for oral presentation will be submitted within April 2010.

A COMPREHENSIVE SAFETY STRATEGY FOR PTW RIDERS AND RELEVANT RESULTS ACHIEVED IN SAFETY IN MOTION (SIM) PROJECT

Santucci M.D.
Pieve M.
PIAGGIO
Italy

Besides the strong need of individual mobility in European countries, Powered-Two-Wheelers vehicles (PTW) are an effective solution to solve traffic congestion and to reduce pollutant emissions.

Nevertheless PTW riders are considered one of the most vulnerable road user categories because the risk of being involved in an accident is several times higher than the risk for a car occupant and the consequences are more severe.

The present paper describes the comprehensive approach adopted by Piaggio & C. S.p.A, leading manufacturing company in the field of motorcycles and scooters with the aim of improving PTW rider safety on the road, and the relevant results in terms of technological solutions developed in EU research projects in which Piaggio is involved.
First, an overview of different aspects of motorcycle safety is provided, describing current situation of PTW's use, the critical aspects that need to be improved as well as an example of suitable and integrated safety strategy for PTW in order to avoid road accidents and mitigate their consequences. On such a basis and according to the Plan for Action 2006-2010 proposed by ACEM, Piaggio took the responsibility to lead the Safety In Motion Project from 2006 to 2009.

Safety In Motion (SIM) project is a research project (funded by the European Commission under the 6th Framework Programme) performed from 2006 to 2009, in which the following tangible results have been obtained:

- One integrated safety concept vehicle equipped with the most relevant safety systems
- Measurement and comparison of the performances of selected safety systems through on road tests and crash tests.

SIM vehicle prototype is based on the innovative and unique tilting three wheelers scooter, Piaggio MP3, selected as the most promising vehicle research platform because of the safety intrinsic characteristics of its vehicle architecture.

PTW safety strategy has been identified for all safety areas (active, preventive and passive) starting from the results of previous accidentology studies (e.g. MAIDS and APROSYS EU projects) and through an in-depth analysis on accident scenarios aimed at evaluating the effectiveness of most promising safety systems applicable to PTWs.

The following safety devices have been implemented in the same vehicle platform (Piaggio MP3):

- Active Brake System;
- Stability management by traction control;
- Semi-Active Suspension System;
- Frontal airbag;
- Inflatable device worn by the rider;
- Information Management concept for motorBikes (IMB);
- Enhanced Human Machine Interface (HMI) made of ergonomic handlebar controls, wireless communication and Head-Up display fitted in the helmet.

Comparative tests have been conducted on SIM prototypes for evaluating the enhancement of active safety level in terms of handling and stability control, both in laboratory and on road.

In preventive safety area, tests on the effectiveness of HMI Information Management concept for motorbike in enhancing the PTW rider’s awareness and comfort have been conducted.

Concerning passive safety, a frontal airbag fitted on PTW (protection against primary impact) and an inflatable wearable device (mainly for the secondary impact) have been implemented while an activation algorithm has been developed.

Their effectiveness has been measured through sled tests and full scale crashes in selected configurations. The reduction of dummy injuries has been compared within the same configurations with and without the presence of safety devices.

SIM project is not only a concrete example of safety enhanced technologies applied to PTW (mainly in terms of active and passive safety) but the obtained results such as the innovative HMI layout and the electronic vehicle management provide the basis for preventive safety solutions to be investigated and developed in other on-going EU research activities focused on PTW rider safety enhancement.

Within this research activity, Piaggio’s commitment in the field of PTW safety is also addressed to Vehicle-to-Vehicle and Vehicle-to-Infrastructure communication systems (i.e. WATCH-OVER and SAFESPOT EU projects) as well as the HMI optimization, Advanced Rider Assistance System and On Board Information Systems (SAFERIDER EU project) that are for sure a key issue for PTW rider’s comfort and safety.
2.3 **6th ACEM Annual Conference**

28/01/2009 Brussels (Belgium)

The ACEM Annual Conference provides the opportunity to have an overview of the motorcycle sector, and engage policy-makers, professionals and company managers in productive discussions – so that current challenges may be turned into opportunities.

SIM final vehicle prototype will be shown.

3. **Conclusions**

SIM Consortium considered dissemination as relevant part for contributing to enhance PTW safety consciousness of all involved stakeholders (public institutions and administrations, policy makers…)

Dissemination of SIM activities from 2006 to 2010 has been accomplished in conferences, workshops and other public events. SIM project has been disseminated by presenting preliminary prototypes, posters and papers, focusing on status of ongoing activities and concrete results.
ANNEXES
Annex 1: ESV 2007

SIM PROJECT: A WAY FOR PTW INTEGRATED SAFETY

20th ESV Conference
Lyon (France) June 18-21, 2007

Federico Galliano - Regulatory Affairs Piaggio & C. SpA

The figures

- In 2004, motorcycle and moped user fatalities made up 20.4% of the total number of road accident fatalities (EU-14)
- The share of moped and motorcycle fatalities as a proportion of total road fatalities is slightly increasing.
- In 2002 the risk rate (fatalities/travelled km) respect to car occupants was 20 times higher for motorcyclists

Source: European Road Safety Observatory

Index (1995=100) of motorcycle and moped fatalities compared with other transport modes (EU-14, 1995-2004)
MAIDS findings

- From the **MAIDS project** (Motorcycle Accidents In-Depth Study, 1998-2004):
  - 72% of accidents happens in urban or semiurban areas.
  - In more than 60% of accidents a passenger car is involved.
  - 20% are single vehicle accidents where the rider lost control of the motorcycle.
  - In 87% of cases the primary contributing factors are human errors (50% for Other Vehicle driver and 37% for PTW rider).

A plan for action: the safety matrix

- The pillars of safety
  - Vehicle (PTW)
  - Human factor
  - Infrastructure

- The safety areas
  - Active
  - Preventive
  - Passive
  - (Post-Crash)
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Establishment of a safety strategy through accident scenarios definition and technology and effectiveness evaluation (July 2007)

Specification of system architecture for active and passive safety devices (December 2007)

Development and validation of the systems components (December 2008)

Safety systems integration in vehicle prototypes for test and validation (June 2008)

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**SIM consortium**

**Industrial partners:**
- PIAGGIO (IT)
- OHLINS (S): suspensions
- DALPHIMETAL (SP): airbags
- CONTINENTAL TEVES (D): electronics, sensors and brake systems
- SAVA (SLO): tyres
- NZI (SP): helmets [SME]

**Universities:**
- University of Pisa (IT)
- Technical University of Prague (CZ)
- University of West Bohemia (CZ)

**Research Centers:**
- CRF (IT)
- CIDAUT (SP)
- DEKRA (D)
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SIM technical targets

- The development and testing of innovative technologies for enhancing safety and comfort in Powered-Two-Wheeler vehicles:
  - Integral Dynamic Stability Control managing subsystems such as semi-active suspensions, traction control and enhanced ABS
  - Innovative Human Machine Interface
  - Aerodynamic studies for improving comfort
  - Integral passive safety solution (airbag, inflatable leg protectors and wearable device)

- The implementation of the above safety features into a new concept of safe vehicle (e.g. tilting 3-Wheelers)

Conclusions

- SIM project aims to generate a prototype as Integral Safety Solution

- An integrated safety approach by following the philosophy of “maximum control with minimum effort” in order to provide easy-to-use and safer PTWs
Annex 2: TRA 2008

Safety In Motion (SIM) PROJECT:
A WAY FOR
PTW INTEGRATED SAFETY

TRA Conference
Ljubljana – 23/04/2008

- From the MAIDS project (Motorcycle Accidents In-Depth Study, 1998-2004):
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• SIM (Safety In Motion): STREP EU FP6 project – started in September 2006
• The project objective is an integrated concept design of motorbike, helmet and clothing with the most relevant technologies in:
  – active safety (advanced brake systems and enhanced suspension control)
  – preventive safety (based on HMI concepts to improve communication vehicle-rider via the helmet and vehicle dashboard)
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Annex 3: APROSYS SP4 Workshop

Safety In Motion (SIM) Project overview and results

Marco Pievo
Scooter Technical Innovation
Piaggio & C. Spa

Workshop
Passive Safety Systems for Motorcycles

DEKRA Crash Test Center - Neumünster (Germany)
21st January 2009

The SIM project

- SIM (Safety In Motion): STREP EU FP6 project – started in September 2006 – will finish in 2009
- The project objective is an integrated concept design of motorbike, helmet and clothing with the most relevant technologies in:
  – active safety (advanced brake systems and enhanced suspension control)
  – preventive safety (based on HMI concepts to improve communication vehicle-rider via the helmet and vehicle dashboard)
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Background: MAIDS findings

- From the MAIDS project (Motorcycle Accidents In-Depth Study, 1998-2004):

  - 72% of accidents happen in urban or semiurban areas.
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The Safety Matrix

- The pillars of safety
  - Vehicle (PTW)
  - Human factor
  - Infrastructure

- The safety areas
  - Active
  - Preventive
  - Passive
  - (Post-Crash)
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System selection and specifications

- The following safety devices to be implemented into the vehicle prototypes have been selected coming from effectiveness evaluation in real accident scenarios and partners’ expertise:
  - Active Brake System
  - Stability management by traction control
  - Semi-Active Suspension System
  - Airbag system
  - Inflatable wearable device
  - HMI management concept for motorbikes
  - Enhanced HMI (ergonomic handlebar controls, wireless communication, Head-Up Display)

Active safety systems

In the first vehicle prototype a stability management system has been implemented:
- ABS (Anti-lock Brake System)
- ABD (Active Brake force Distribution)
- RLP (Rear wheel Lift-off Protection)
- BTCS (Brake Traction Control System)

A automatic variable damping Suspension system have been designed and implemented.

A CAN bus architecture has been defined and realized in order to guarantee the ECUs communication for system interaction.
HMI definition and implementation

The Info Management System elaborates data gathered from SIM C-CAN bus and gets visual information to rider:
- (visual mode) through IMB display
- (audio mode) in helmet speakers

Additional info are provided directly from vehicle and displayed in the HUD integrated in the helmet.

Passive safety systems

A frontal airbag system and an inflatable device worn by rider are going to be implemented as passive safety solutions.
- In Aprosys SP4 some crashes in 413 and 114 configuration have been performed in order to collect data useful for TTF algorithm development
- In SIM a FE model of the MP3 vehicle has been realized and numerical analyses have been performed (against rigid wall and car).
- Sled tests for airbag functioning have been made
- Full crashes with inflatable device have been done in October 2008
- Full crashes with airbag will be performed in February and March 2009
MP3 as safe concept vehicle

- MP3 has been chosen as research platform in order to test all the relevant safety features that could be realistically applied to a PTW

SIM Project at glance

- SIM project aims at generating a prototype as Integral Safety Solution
- An integrated safety approach by following the philosophy of "maximum control with minimum effort" in order to provide easy-to-use and safer PTWs

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Thank you for the attention

Marco Pieve
Scooter Technical Innovation
Piaggio & C. SpA
marco.pieve@piaggio.com

www.sim-eu.org
Annex 4: **International Motorcycle Symposium 2009**

The third wheel: a concrete contribution to PTW safety

Marco Pievè  
Scooter Technical Innovation  
Piaggio & C. Spa

International Motorcycle Symposium 2009  
Berlin – 21 and 22 September 2009

Sustainable mobility: 3 global challenges.

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PTWs vs. cars

Research performed by ADEME at Paris on circular route (31 km) Banlieue-Orsay Museum in different traffic conditions.

<table>
<thead>
<tr>
<th>Type</th>
<th>CO₂/km</th>
<th>Fuel Consumption/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small petrol car</td>
<td>180</td>
<td>13.2</td>
</tr>
<tr>
<td>Small diesel car</td>
<td>150</td>
<td>17.7</td>
</tr>
<tr>
<td>Large petrol car</td>
<td>270</td>
<td>6.9</td>
</tr>
<tr>
<td>Medium displacement Scooter</td>
<td>90</td>
<td>26.0</td>
</tr>
</tbody>
</table>

Travel time:
Auto: 88 min  Scooter: 45 min

Scooter / Motorcycle vs Car
- Travel time reduced by 50%
- Up to 65% less fuel consumption
- Up to 75% less CO₂ emission

Effective but not popular solution

- Beside the strong need of individual mobility, two wheeler users in Europe represent a small percentage.
- Over 70% of people can ride a bicycle, but do not use a PTW for urban mobility.

Main reason is the perception of a lack of safety respect to other transport means.

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The Safety Matrix

The pillars of safety
- Vehicle (PTW)
- Human factor
- Infrastructure

The safety areas
- Active
- Preventive
- Passive
- (Post-Crash)

Passive safety deals with devices that help rider to avoid accidents, mainly improving vehicle control in emergency situations.

Thematic areas:
- Advanced braking systems
- Traction control
- Brake by wire
- Electronic suspensions
- Aeroacoustic and thermal comfort

Preventive safety aims at improving safety margin, providing information to rider about potential risk.

Thematic areas:
- HMI improvement
- Vehicle-to-vehicle comm.
- Vehicle-to-Infrastructure comm.
- Enhanced conspicuity

Active safety deals with devices that help rider to avoid accidents, mainly improving vehicle control in emergency situations.

Thematic areas:
- Maintenance, featuring ...
- e-Safety
- e-Cell

Passive safety field covers all systems and devices designed for rider protection in case of accident.

Thematic areas:
- Vehicle architecture
- Airbag jacket
- Airbag on vehicle
- Inflatable leg protectors

How to improve PTW safety: R&D guidelines

Mitigating consequences
Avoiding accidents
Enhancing safety margin
The third wheel: Piaggio MP3

International Motorcycle Symposium - Berlin 21-22 September 2009

Does the third wheel really enhance PTW safety?
First of all, let's find your equilibrium

– Cars (static equilibrium vehicles) are stable without need of steering control actions.

– Two-wheelers (dynamic equilibrium vehicles) are kept stable only by means of continuous and almost unnoticed trajectory modifications:

– in order to keep vehicle control, the adherence of front wheel is crucial;

On a correctly designed tilting three wheelers, the roll motion is completely free. The equilibrium conditions in curve are the same of a conventional two wheelers and the tilting angle is determined by forward speed and bend radius with single external forces aligned with vehicle symmetry plane.
The (third) wheel invention

- More contact surface where needed
- Steadiness of the force that produces adherence,
- Reduction of the sensitivity to road “defects” (bumps, potholes, tram tracks...).
- Better usage of adherence during brake manoeuvres (thanks to load transfer on the front wheels)

The safety improvement of Piaggio MP3 is not only due to the third wheel but how the front suspension is built

Dynamic behaviour

- Dynamic equilibrium condition
- No dynamic roll-over limit
- Handling characteristics independent from track value.
- Uniform wheel load distribution (no lateral load transfer)
In other words...

Riding behaviour is identical to the motorcycle one (initial counter-steering for direction changes) but each tire is supporting almost half the load with better responsiveness and higher limits.

Can Mp3 be considered as a scooter with wide tires (2x120mm)?

Two small tires take more advantages than twice as wide one

Handling

Compared to a standard scooter, numerical simulations and track tests show that in the same slalom manoeuvre the Mp3 requires less overall tire usage (side slip angles) that is translated in higher precision and riding feeling.

Also the initial counter-steer phase is less perturbed and easier to manage for average users.
Safety feeling

The dynamic behaviour in every road situation and surface condition provides an immediate safety feeling.

Experimental measurements of “ground contact forces” is the key parameter that gives explanation of such a feeling.

Advantages on uneven surfaces

The contact force is almost steady due to the tire-ground contact probability (at least one wheel is in contact) so the risk of sudden adherence loss is almost cut by half (a loss of vehicle front end can not be recovered).
Advantages in braking

MP3 architecture gives measurable improvements during braking on every road surface, matching ABS equipped vehicles. The difference between MP3 and conventional two wheelers is magnified on rough roads, due to the steadiness of ground contact force. The MP3 performance drop while passing from good to bad surfaces (i.e. paved roads) is 56% less than conventional one.

<table>
<thead>
<tr>
<th>Stopping distance from 40Km/h</th>
<th>Mp3</th>
<th>Ptw</th>
<th>Var%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat track</td>
<td>9m</td>
<td>10.3m</td>
<td>-12%</td>
</tr>
<tr>
<td>Paved road</td>
<td>10m</td>
<td>12.6m</td>
<td>-21%</td>
</tr>
<tr>
<td>Performance drop</td>
<td>9.5%</td>
<td>26.5%</td>
<td>-56%</td>
</tr>
</tbody>
</table>

The solution spreading

In two years 43,600 MP3 have been produced and sold, mainly in urban areas and cities strongly affected by traffic jam such as Paris and Rome.
MP3 as safe concept vehicle

MP3 (tilting three-wheelers) has been chosen as research platform in order to test all the relevant safety features that could be realistically applied to a PTW.

The SIM project

SIM (Safety In Motion): STREP EU FP6 project – 2006-2009

Aimed at identifying a suitable safety strategy for PTW

Final result is an integrated concept design of motorbike (MP3), helmet and clothing with the most relevant technologies in:

– active safety (advanced brake systems and enhanced suspension control)
– preventive safety (based on HMI concepts to improve communication vehicle-rider via the helmet and vehicle dashboard)
– passive safety (study of crashworthiness and occupant safety integral solutions)
Background: MAIDS findings

Motorcycle Accidents In-Depth Study, (ACEM 1998-2004):

- 72% of accidents in urban or semiurban areas.
- In more than 60% of accidents a passenger car is involved
- 20% are single vehicle accidents (e.g. loss of control)
- In 87% of cases the primary contributing factors are human errors (rider and car driver)

SIM project structure and activities flow

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SIM output: active safety systems

Stability management system:
- FIB (Full Integral Brake)
- ABD (Active Brakeforce Distribution)
- RLP (Rear wheel Lift-off Protection)
- BTCS (Brake Traction Control System)

Automatic variable damping suspension:
- Setting switch (Auto, Sport, Comfort)

Based on CAN bus architecture

SIM output: passive safety systems

The main results from virtual simulation, sled tests and full crashes are a cooperative architecture composed by:
- a frontal airbag system
- an inflatable device worn by rider
- activation system (ECU, nose and satellite sensors)
Conclusions

Tilting three wheelers such as MP3 contributes to PTW safety, enhancing the vehicle control in normal and emergency manoeuvres;

Some advanced features can be implemented to improve active and passive safety level;

PTW rider safety is a complex phenomenon that requires the common effort of all stakeholders.

In particular, human factor plays a key role and can be enhanced in terms of:
- Training and education
- PTW rider awareness

More head more safety!
Thank you for the attention

Marco Pieve  
Scooter Technical Innovation  
Piaggio & C. SpA  
marco.pieve@piaggio.com

www.sim-eu.org