MAIDS Workshop

01 April 2009
Road Safety: the Industry Strategy

- Improve the knowledge

- Safety Plan for Action: Integrated approach
  - Act on the product
  - Act on the human factor
  - Act on the infrastructure

- Cooperate with institutions and stakeholders
Motorcycle Accidents In-Depth Study
Agenda

- PRESENTATION OF THE STUDY – HIGHLIGHTS
- COMPARISON L1/L3 VEHICLES
- FOCUS ON 125cc
- MULTIVARIATE ANALYSIS ON FATAL ACCIDENTS
- MAIDS COOPERATION & FURTHER RESEARCH
- DISCUSSION
Presentation of the study – Highlights
Overview

www.maidas-study.eu

In-Depth investigation of motorcycle accidents
Decision

• To provide the scientific basis for the discussion of MC accidents in Europe:

  – ACEM organised the Motorcycle Accident In-Depth Study (MAIDS);

  – Created a Consortium of partners, namely:
    • DG TREN of the European Commission, who co-financed the project.
    • Other partners: BMF, CEA, CIECA, FEMA, FIM.
Who and Where?

• For data collection
  - France  CEESAR  Centre Européen d’Etudes de Sécurité et d’Analyse des Risques
  - Germany MUH  Medical University of Hanover
  - Italy  Uni Pavia  University of Pavia
  - Netherlands TNO  Nederland's Organization for applied scientific research
  - Spain REGES  Investigación y reconstrucción de accidentes de tráfico

• For statistical analysis
  - Uni Pavia (Italy)
Main Features

- OECD methodology
- Basic parameters of accidents
- In-depth data on human, vehicle and roadside factors (about 2000 variables per case)
- Data on collision dynamics
- Data on injury types and severity
- Data on accident causation
Main Features

All 921 accident cases reconstructed

- Allowing MAIDS teams to identify
- Accident Contributing Factors

- For each case
  - One single primary accident contributing factor
  - Four additional accident contributing factors
  - Attributed to
    - Human
    - Vehicle
    - Environment
Main Features

• Exposure data
  – Essential for comparison purpose and risk evaluation
  – 923 exposure cases
Presentation of the study – Highlights

Vehicle factors
Primary Accident Contributing Factors

- Vehicle factors: 0.3% of all cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Additional Accident Contributing Factors

• Vehicle factors:
  – PTWs: 1.6 % of all cases
  – OV: 0.5 %

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTW technical failure</td>
<td>32</td>
<td>1.6</td>
</tr>
<tr>
<td>OV technical failure</td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>2059</td>
<td>100.0</td>
</tr>
</tbody>
</table>

  – 5% of all contributing factors
  72% of all PTW vehicle failures were related to the tyre
  11 related to brakes problems (1.2%)
PTW Style

- Frequency
  - Scooters: 38%
  - Conventional street: 14%
- No associated risk
PTW Engine Displacement

- **Frequency**
  - 50 cc: 43 %
  - 501 - 750 cc: 22 % of all cases

- **No associated risk**
- **Except for the over 1001 cc category under-represented**

<table>
<thead>
<tr>
<th>Engine displacement</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 50 cc</td>
<td>394</td>
<td>42.7</td>
<td>367</td>
<td>39.8</td>
</tr>
<tr>
<td>51 to 125 cc</td>
<td>89</td>
<td>9.7</td>
<td>86</td>
<td>9.3</td>
</tr>
<tr>
<td>126 to 250 cc</td>
<td>37</td>
<td>4.0</td>
<td>32</td>
<td>3.5</td>
</tr>
<tr>
<td>251 to 500 cc</td>
<td>56</td>
<td>6.1</td>
<td>50</td>
<td>5.4</td>
</tr>
<tr>
<td>501 to 750 cc</td>
<td>206</td>
<td>22.4</td>
<td>193</td>
<td>20.9</td>
</tr>
<tr>
<td>751 to 1000 cc</td>
<td>80</td>
<td>8.7</td>
<td>107</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>1001 or more</strong></td>
<td><strong>58</strong></td>
<td><strong>6.3</strong></td>
<td><strong>88</strong></td>
<td><strong>9.5</strong></td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>921</td>
<td>100.0</td>
<td>923</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Braking Systems

- Few cases with Advanced Braking Systems (not statistically significant)
- Exposure data biased

<table>
<thead>
<tr>
<th></th>
<th>Accident data</th>
<th>Exposure data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>No ABS, CBS</td>
<td>893</td>
<td>97.0</td>
</tr>
<tr>
<td>CBS only, no ABS</td>
<td>20</td>
<td>2.2</td>
</tr>
<tr>
<td>ABS</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>ABS and CBS</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
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Braking Systems

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<tr>
<td>No ABS, CBS</td>
<td>893</td>
<td>97.0</td>
<td>869</td>
<td>94.2</td>
</tr>
<tr>
<td>CBS only, no ABS</td>
<td>20</td>
<td>2.2</td>
<td>26</td>
<td>2.8</td>
</tr>
<tr>
<td>ABS</td>
<td>4</td>
<td>0.4</td>
<td>22</td>
<td>2.4</td>
</tr>
<tr>
<td>ABS and CBS</td>
<td>2</td>
<td>0.2</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>0.2</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
<td>923</td>
<td>100.0</td>
</tr>
</tbody>
</table>
• ABS effectiveness is limited by the relatively large number of accidents (i.e., 80 to 87%) in which there is no braking, sub-limit braking, or swerve-and-brake, for which ABS will not have an effect.
Presentation of the study – Highlights

Environment factors
Primary accident causation factor

- Environmental factors: 8%

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>71</td>
<td>7.7</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- Weather: 2%
- Road maintenance defect: 2%
- Road design defect: 1%
- Traffic hazard: 1%
Additional Accident Contributing Factors

- From the road environment: 15%

<table>
<thead>
<tr>
<th>Environmental cause</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental cause</td>
<td>300</td>
<td>14.6</td>
</tr>
<tr>
<td>Total</td>
<td>2059</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- Weather 5%
- Road Maintenance defect 1%
- Road design defect 2%
- Traffic hazard 2%
Worsening Factors

- Roadway and fixed objects: second collision partner with 17% of MAIDS cases
  - L1 = 9%
  - L3 = 23%

<table>
<thead>
<tr>
<th>Fixed object</th>
<th>74</th>
<th>8.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway</td>
<td>83</td>
<td>9.0</td>
</tr>
</tbody>
</table>
Presentation of the study – Highlights

Human factors
Primary Accident Contributing Factors

• Human factors: 88 % of all cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human-PTW rider failure</td>
<td>344</td>
<td>37.4</td>
</tr>
<tr>
<td>Human-OV driver failure</td>
<td>465</td>
<td>50.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>809</strong></td>
<td><strong>87.9</strong></td>
</tr>
</tbody>
</table>

• OV drivers: largely responsible for PTW crashes
  – 50 % of all MAIDS cases (L1 = L3)
  – 61 % of the multi-vehicle accidents

• PTW riders: responsible of 37 % of PTW crashes
  – L1 = 39 %
  – L3 = 36 %
Primary Accident Contributing Factors

Fatal Cases

- Human factors: 86 % of all cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human-PTW rider failure</td>
<td>54</td>
<td>52,4</td>
</tr>
<tr>
<td>Human-OV driver failure</td>
<td>34</td>
<td>33,3</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>85,7</td>
</tr>
</tbody>
</table>

- PTW riders: largely responsible for PTW fatal accidents
  - 52 % of MAIDS fatal cases

- OV drivers: responsible of
  - 33 % of all MAIDS fatal cases
  - 44 % of the multi-vehicle fatal accidents
Primary Accident Contributing Factors

PTW rider
- Perception failure: 110
- Comprehension failure: 33
- Decision failure: 123
- Reaction failure: 51
- Other failure: 27

OV driver
- Perception failure: 337
- Comprehension failure: 91
- Decision failure: 22
- Reaction failure: 13
- Other failure: 0
Primary Accident Contributing Factors

• The most frequent: perception failure by the OV drivers

- 37% of all MAIDS cases
- 72% of the drivers’ failures
  - L1 = 77%
  - L3 = 69%
Primary Accident Contributing Factors

- The second most frequent attributable to PTW riders

  - Decision failure

  13% of all MAIDS cases
  35% of riders’ failures

  \[ L_1 = L_3 \]

  ![Decision Failure Chart]

  - Perception failure
  - Comprehension failure
  - Decision failure
  - Reaction failure
  - Other failure
Primary Accident Contributing Factors

- The third most frequent attributable to PTW riders
  - Perception failure
    - 12% of all MAIDS cases
    - 32% of riders’ failures
      - L1 = 17%
      - L3 = 8%

Perception
Additional Accident Contributing Factors

- Human factors: 72% of all cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTW rider</td>
<td>900</td>
<td>43.7</td>
</tr>
<tr>
<td>OV driver</td>
<td>589</td>
<td>28.6</td>
</tr>
<tr>
<td>Total</td>
<td>2059</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- PTW riders: major contributors to crashes
  - 44% of all additional contributing factors
    - L1 = 47%
    - L3 = 31%
What does MAIDS tell us?

• Human factors are predominant in accident causations
  – Perception failures from OV drivers
  – Decision and perception failures from PTW riders
  – Additional accident contributing factors from PTW riders

• Environmental factors
  – Are more worsening than contributing factors (excluding weather conditions)
  – An entry point to engage with national/local authorities in PTW integration
  – Can potentially help riders and drivers (better decision, better perception)

• Vehicles factors
  – Marginal accident causation
  – More significant in accident contribution
  – Linked to maintenance defect
Comparison L1/L3 vehicles
General accident characteristics
Main Figures

- Distribution of cases according to category
  - L1 mofas = 28
  - L1 mopeds = 370
  - L1 total = 398
  - L3 motorcycles = 523
Main Figures

- Distribution of cases and controls according to category

Table 3.3: PTW legal category

<table>
<thead>
<tr>
<th></th>
<th>Accident data</th>
<th></th>
<th>Exposure data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>L1 vehicle - mofa</td>
<td>28</td>
<td>3.0</td>
<td>49</td>
<td>5.3</td>
</tr>
<tr>
<td>L1 vehicle - other</td>
<td>370</td>
<td>40.2</td>
<td>324</td>
<td>35.1</td>
</tr>
<tr>
<td>L3 vehicle</td>
<td>523</td>
<td>56.8</td>
<td>550</td>
<td>59.6</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
<td>923</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- L1 = 40 %, over-represented (moped only)
- L3 = 57 %, no over-representation
Main Figures

• Distribution of fatal and non-fatal cases

<table>
<thead>
<tr>
<th></th>
<th>Fatal</th>
<th>Not fatal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Pavia</td>
<td>11</td>
<td>189</td>
<td>200</td>
</tr>
<tr>
<td>(Italy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNO (Netherlands)</td>
<td>15</td>
<td>185</td>
<td>200</td>
</tr>
<tr>
<td>REGES (Spain)</td>
<td>12</td>
<td>109</td>
<td>121</td>
</tr>
<tr>
<td>ARU-MUH (Germany)</td>
<td>49</td>
<td>201</td>
<td>250</td>
</tr>
<tr>
<td>CEESAR (France)</td>
<td>16</td>
<td>134</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>103</td>
<td>818</td>
<td>921</td>
</tr>
</tbody>
</table>

- Fatal 11 %
  - L1 = 24 %, under-represented
  - **L3 = 76 %, over-represented**
- Non-fatal 89 %
Main Figures

- L1/L3 accident characteristics
  - L1
    - Multivehicle 91%
    - Urban 86%
    - Intersection 62%
  - L3: effect of single accidents in rural areas (20% of L3)
    - Less multivehicle 79%
    - Less urban 62%
    - Less intersection 48%
Rationale for Action
1 - Primary Accident Contributing Factors

• PTW riders: responsible of 37 % of PTW crashes

<table>
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<tr>
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<th>Frequency</th>
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<tbody>
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</tr>
<tr>
<td>Total</td>
<td>809</td>
<td>87,9</td>
</tr>
</tbody>
</table>

• No significant difference in proportion of failures but
  – L1 = 39 % riders failed more in perceiving the hazard
  – L3 = 36 %, riders tended to make more decision failures (including speeding as contributor to the accident)
2 - Additional Accident Contributing Factors

• Human factors: 72% of all cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>PTW rider</td>
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<td>43.7</td>
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<td>589</td>
<td>28.6</td>
</tr>
<tr>
<td>Total</td>
<td>2059</td>
<td>100.0</td>
</tr>
</tbody>
</table>

• PTW riders: major contributors to crashes
  – 44% of all additional contributing factors
    – L1 = perception and reaction failures
    – L3 = reaction and decision failures
3 - Alcohol and Drug

- Alcohol and drug use by the PTW rider: 5% of all cases
- Over-represented
  - L1 = 3% (7% of L1)
  - L3 = 2% (3% of L3)
  - OV = 3%

<table>
<thead>
<tr>
<th></th>
<th>Accident data</th>
<th></th>
<th>Exposure data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>None</td>
<td>853</td>
<td>92.6</td>
<td>902</td>
<td>97.8</td>
</tr>
<tr>
<td>Alcohol</td>
<td>36</td>
<td>3.9</td>
<td>14</td>
<td>1.5</td>
</tr>
<tr>
<td>Drug</td>
<td>5</td>
<td>0.5</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Alcohol+drug</td>
<td>2</td>
<td>0.2</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Unknown</td>
<td>25</td>
<td>2.7</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
<td>923</td>
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</tr>
</tbody>
</table>

Note: drug use is defined as the use of illegal, non-prescription drugs (e.g., cocaine).
4 - PTW Rider Licence

- **5 % without licence (required)!**
  - L1 = 11 %
  - L3 = 1 %
- **13% with a licence, but for vehicles other than a PTW (equivalence)**
- **11 % licence was not required to operate the vehicle (mopeds)**

**Riders without licence are over-represented**

<table>
<thead>
<tr>
<th>PTW licence qualification</th>
<th>Accident data</th>
<th></th>
<th>Exposure data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>None, but licence was required</td>
<td>47</td>
<td>5.1</td>
<td>13</td>
<td>1.4</td>
</tr>
<tr>
<td>Learner's permit only</td>
<td>4</td>
<td>0.4</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>PTW licence</td>
<td>608</td>
<td>66.0</td>
<td>697</td>
<td>75.6</td>
</tr>
<tr>
<td>Only licence for OVs other than PTW</td>
<td>125</td>
<td>13.6</td>
<td>125</td>
<td>13.5</td>
</tr>
<tr>
<td>Not required</td>
<td>104</td>
<td>11.3</td>
<td>86</td>
<td>9.3</td>
</tr>
<tr>
<td>Unknown</td>
<td>33</td>
<td>3.6</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
<td>923</td>
<td>100.0</td>
</tr>
</tbody>
</table>
5 & 6 - Rider Age

- 18 - 25: over-represented
- L1 = L3
- 41 - 55: under-represented
- L3
- >56: under-repr.
- L1

< 17 equally represented
- L1
OV drivers who also have a PTW licence are much less likely to commit a perception failure (L1 = L3)

OV drivers who only have a car licence are likely to commit a perception failure (L1 = L3)
9 – Neglect Visual Obstruction

- Present in about 1/3 of accidents
  - L1 = 35%
  - L3 = 24%
  - OV=16%
10 - Traffic Control Violation

• PTW riders: 24 % of cases when traffic control present
  – L1 = 15 %
  – L3 = 9 %

<table>
<thead>
<tr>
<th>Traffic control violated by PTW rider</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>235</td>
<td>25.6</td>
</tr>
<tr>
<td>Yes</td>
<td>73</td>
<td>7.9</td>
</tr>
<tr>
<td>Unknown if traffic control was present or if traffic control was violated</td>
<td>17</td>
<td>1.8</td>
</tr>
<tr>
<td>Not applicable, no traffic control present</td>
<td>596</td>
<td>64.7</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
</tr>
</tbody>
</table>

• OV drivers: 41 % of cases when traffic control was present
11 – Accident configurations

- Wide diversity, no specific accident configurations
  - L1 = L3
12 – Risk location

- In front of riders: 90 %
  - L1 = 87 %
  - L3 = 92 %
14 - Collision partners

- OV first collision partner
  - L1 = 85 %
  - L3 = 71 %

- Roadway and fixed objects: second collision partner with 17 % of MAIDS cases
  - L1 = 9 %
  - L3 = 23 %
15 - Tampering

• L1 only (visual inspection)
  – Accident cases = 18 % > Over-represented
  – Exposure cases = 12 %

• Other indication
  – 40% L1 fatal accidents occur at travel speeds greater than 50 km/h
18 - PTW Impact speed

- 75% of PTW crashes occurred at speeds below 50 km/h
  - L1 = 95%
  - L3 = 62%
- Only 5.4% of impacts were at speeds of 100 km/h or higher
  - L3 = 9%

<table>
<thead>
<tr>
<th>PTW Impact speed (all accidents)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 km/h</td>
<td>14</td>
<td>1.5</td>
</tr>
<tr>
<td>10 km/h</td>
<td>44</td>
<td>4.8</td>
</tr>
<tr>
<td>20 km/h</td>
<td>124</td>
<td>13.4</td>
</tr>
<tr>
<td>30 km/h</td>
<td>194</td>
<td>21.1</td>
</tr>
<tr>
<td>40 km/h</td>
<td>185</td>
<td>20.1</td>
</tr>
<tr>
<td>50 km/h</td>
<td>128</td>
<td>13.9</td>
</tr>
<tr>
<td>60 km/h</td>
<td>70</td>
<td>7.6</td>
</tr>
<tr>
<td>70 km/h</td>
<td>45</td>
<td>4.9</td>
</tr>
<tr>
<td>80 km/h</td>
<td>40</td>
<td>4.3</td>
</tr>
<tr>
<td>90 km/h</td>
<td>25</td>
<td>2.7</td>
</tr>
<tr>
<td>100 km/h or higher</td>
<td>50</td>
<td>5.4</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100.0</td>
</tr>
</tbody>
</table>
19 - Unusual Travelling Speed

- PTW 18%
  - L1 = 14%
  - L3 = 21%
- OV 5%

### Speed compared to surrounding traffic (PTW)

<table>
<thead>
<tr>
<th></th>
<th>L1 vehicles</th>
<th></th>
<th>L3 vehicles</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
<td></td>
<td>Percent</td>
</tr>
<tr>
<td>Speed unusual but no contribution</td>
<td>35</td>
<td>8.8</td>
<td>39</td>
<td>7.5</td>
<td>74</td>
<td>8.1</td>
</tr>
<tr>
<td>Speed difference contributed to accident</td>
<td>57</td>
<td>14.3</td>
<td>109</td>
<td>20.8</td>
<td>166</td>
<td>18.0</td>
</tr>
<tr>
<td>No unusual speed or no other traffic (not applicable)</td>
<td>305</td>
<td>76.6</td>
<td>375</td>
<td>71.7</td>
<td>680</td>
<td>73.8</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0.3</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>398</td>
<td>100.0</td>
<td>523</td>
<td>100.0</td>
<td>921</td>
<td>100.0</td>
</tr>
</tbody>
</table>
20 - Collision avoidance manoeuvre

- 62% of all PTW riders attempted some form of collision avoidance
- 31% experienced some type of loss of control during the manoeuvre
- L1 = 52 % attempted, 16% lost control
- L3 = 70 % attempted, 44 % lost control
21 - Helmet Wearing

- 90.4% of the PTW riders wore helmets
- 9.1% of these helmets came off during accident
  - L1 = 80% worn, 10% off
  - L3 = 99 % worn, 2 % off
22 - Injuries

- 921 accidents
- 3417 injuries
- $L_1 = L_3$
23 - Crash Barriers

- 60 L3 rider injuries were associated with barrier contact (6.5%)
24 – Road Maintenance Defects

- Cause or contributing factor: 4 %
  - L1 = L3
25 – Traffic hazard

• Cause or contributing factor: 4 %
  – L1 = 4 %
  – L3 = 3 %
26 – Weather

• Cause or contributing factor: 7%
  – L1 = 4%
  – L3 = 10%
Conclusion

L1 (moped + mofa)

- Accident characteristics
  - In urban areas,
  - At intersections
  - Involvement of a passenger car
  - Commuting use

- Riders characteristics
  - 18/25 years over-represented
  - Over 56 less involved

L3 (motorcycle)

- Accident characteristics
  - In urban and rural areas
  - Intersections = non intersection
  - Impact passenger car + environment (4 X / L1) + single
  - Commuting & leisure use

- Riders characteristics
  - 18/25 years over-represented
  - 41/55 years under-represented
L1 (moped + mofa)

- Riders behaviour
  - More unsafe acts:
    - Not having a license
    - Neglecting some view obstructions
    - Violating traffic controls
    - Lower rate of helmet wearing
    - More alcohol or drugs impairment
  - Main mistakes
    - Perception failure
    - 40% of cases the rider did not attempt any kind of reaction to avoid the hazard

L3 (motorcycle)

- Riders behaviour
  - Unsafe act:
    - Neglecting some view obstructions
    - Less violating traffic controls
    - Less alcohol or drug impairment
  - Main mistakes
    - Decision failure (more unusual speed & high speed)
    - Avoidance manoeuvre but many loss of control 44%
Focus on 125cc
Background

• The B-A1 equivalence option available to MS under the 2DLD 3DLD confirmed this possibility for MS

• The B-A1 equivalence currently accounts for a large part of A1 use (and market)

• A1 vehicles largely used for urban mobility needs

• 3DLD will progressively refocus the PTW market towards smaller capacity vehicles, A1 light motorcycle licence category being harmonised across the EU.
Both A1 riders having only a car license or a motorcycle license were found to be over-represented in accidents when compared to controls.
Riders’ Profile

- Riders with only a MC license equally spread through PTW style (Age 16-17)

- Riders using the equivalence are more prone to ride a scooter (Age 25-55)

- Both rider categories mainly use their 125 in urban environment

- Accident riders using equivalence occurred during the week

- Riders with only MC license also occur during the weekend.
Compared Skills

- MC licensed riders more perception failures
- Riders using the equivalence more comprehension failures
- Major primary contributing factor is still a failure by OV driver
- Riders using the equivalence are more likely to have a skill deficiency (22.2% vs. 12.1%)
- Riders with MC license have more loss of control (42.4% vs. 37%)
- Both riders categories performed evasive manoeuvre. However 44.4% of riders using the equivalence failed, compared to the 15.2% of riders with MC license.
Suggested Conclusion

• Data suggests different level of practical skills between riders using the equivalence and MC licenced riders

• Minimum of practical training would contribute to a safer equivalence

• Caution: low numbers
Multivariate Analysis on fatal Accidents
Purpose

Perform a multivariate analysis of the MAIDS database (fatal accidents only) to identify the presence of any relationships between certain accident factors and PTW legal category.

i. Human factors
ii. Vehicle factors
iii. Environmental factors
iv. Crash factors
Methodology

- Selection of a fatal accident as the outcome of analysis

- Use logistic regression & develop probabilistic models to identify those factors which have a statistically significant contribution to a fatal outcome

- Using odds ratios, quantify how certain characteristics will increase or decrease the odds of being involved in a fatal accident
What is logistic regression?

\[ \text{logit}(\pi) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \]

By looking at several variables at once, you can better understand the relationship between variables and the effect that one variable has upon the outcome event (i.e. a fatal accident)
## Results

<table>
<thead>
<tr>
<th></th>
<th>MAIDS Database (All PTWs)</th>
<th>L1 Database</th>
<th>L3 Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>100</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>Not fatal</td>
<td>821</td>
<td>373</td>
<td>448</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>398</td>
<td>523</td>
</tr>
</tbody>
</table>
**Number of factors by category**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>6</td>
</tr>
<tr>
<td>Vehicle</td>
<td>9</td>
</tr>
<tr>
<td>Collision</td>
<td>7</td>
</tr>
</tbody>
</table>
## Quantitative elements

### TIME OF DAY

The majority of accidents occurred during daytime

The proportion of the number of the fatal accidents to number of accidents is higher during the night time

### TYPE OF AREA

For L1 vehicles, more fatalities occurred in an urban area

For L3 vehicles a larger number of fatalities occurred in a rural area
## Quantitative elements

### TYPE OF ROADWAY

The majority of PTW fatalities occurred on straight roadways

16.5% of all L3 vehicle crashes that took place on a curved roadway resulted in a PTW rider fatality

### TYPE OF ROADWAY

PTW fatalities occur on major arterials (40%)

Major arterial accidents account for 44% of L1 rider fatalities, 39% of L3 rider fatalities and 40% of all PTW rider fatalities
Quantitative elements

**PRESENCE OF INTERSECTION**

The majority of the accidents took place at an intersection (60% of cases)

The majority of PTW rider fatalities took place at a non-intersection location (62% of all PTW rider fatalities)

**PTW STYLE**

Scooter style vehicles was found to have the highest frequency of L1 rider fatalities

Sport replica style motorcycles was found to have the highest reported frequency of L3 rider fatalities
Quantitative elements

AGE OF THE RIDERS

The majority of L1 riders were between the ages of 16 and 21. The L1 rider fatalities were distributed across all L1 rider age groups.

The highest frequency of L3 rider fatalities were between 26 and 40.

SPEEDING

15% of L1 and 32% of L3 riders were speeding at the time of the crash.

Out of those, 12% (or 7 cases) resulted in a L1 rider fatality.

24% of the L3 riders (or 40 cases) resulted in a L3 rider fatality.
Quantitative elements

PTW RIDER ERROR

40% of all L1 vehicle crashes involved a L1 rider error
64% of L1 fatal crashes involved rider error

These data indicate a larger percentage of rider error occurs in fatal crashes in comparison to all crashes

OV DRIVER ERROR

51% of all PTW crashes involve OV driver error, whereas only 33% of fatal crashes involve OV driver error (for both L1 and L3 vehicles)

These data indicate a smaller percentage of OV driver error occurs in fatal crashes, in comparison to all crashes
Summary Multivariate analysis
All PTWs

- PTW riders over 41 years of age appear to be at greater risk
- PTW riders between 18 to 21 years appear to have lesser risk of being involved in a fatality when compared to 26 to 41 year old PTW riders
Summary Multivariate analysis
All PTWs

• There is a significant increase in the risk of a PTW rider fatality when the accident takes place on a major arterial roadway

• Accidents that take place at a site other than an intersection appear to have a greater risk of PTW rider fatality

• When other factors are taken into consideration, no vehicle factors were found to be statistically significant predictors of a PTW rider fatality

• For every 10 km/h increase in crash speed, the odds of a PTW rider fatality increase by 1.31
Summary – L1

- Urban accidents have a reduced risk of fatality when compared to rural accidents.

- Nighttime accidents have a greater risk of fatality when compared to daytime accidents (odds ratio = 1.06).

- Accidents involving a collision with a fixed object have an 8.1 times greater risk of involving a L1 rider fatality when compared to a collision with a light passenger vehicle.
Summary – L1

- For every 10 km/h increase in crash speed, the odds of a L1 rider fatality increase by 1.24

- Other vehicle driver impairment significantly increased the odds of a L1 rider fatality (odds ratio = 5.74)

- L1 rider errors significantly increased the odds of a L1 rider fatality (odds ratio = 3.37)

- The risk of a L1 rider fatality increases with age. L1 riders over 41 years of age have an 8.5 times greater risk of being involved in a fatality when compared to L1 riders that are 26-40 years of age.
Summary – L3

• Travelling speed was found to be a significant factor in predicting an L3 rider fatality. For every 10 km/h increase in traveling speed, the odds of a L3 rider fatality increase by 1.38.

• Environmental factors (i.e., intersections and major arterial roadways) were also found to be significant in predicting an L3 rider fatality.

• L3 vehicle engine displacement and L3 vehicle maximum velocity are not significant predictors of an L3 rider fatality.
Summary – L3

- L3 rider age was not a good predictor of an L3 rider fatality.
- However, when considering L3 rider speeding, L3 riders aged 22-25 were found to have a significant increase in risk of L3 rider fatality when compared to L3 riders aged 26 to 40 years.
- OV driver errors were not found to be a significant predictor of an L3 rider fatality.
EXTERNAL COOPERATION
FURTHER RESEARCH

- eSUM project – analysis on urban accidents
- PPE – fact sheet for dealers, few findings on PPE effect in preventing or mitigating injuries:

Upper Torso and Upper extremities

**L1 riders**
- Light and medium garment – 73% (in three accidents out of four)
- Heavy garment – 93% (almost in all cases)

**L3 riders**
- Light and medium garment – in 69% (in two accidents out of three)
- Heavy garment – in 92% (almost in all cases)
PPE – a few findings on PPE effect in preventing or mitigating injuries

Lower Torso and Lower extremities

L1 and L3 riders
• Light and medium garment – one accident out of two (in 54% of the cases)

L3 riders
• Heavy garments – all most all accident cases (96% of all the cases)

Footwear

L1 rider
• Light: 50% (in one accident out of two)
• Heavy: 89% (in almost all cases)

L3 rider
• Light: 46% (one accident out of two)
• Heavy: 93% (almost all accidents)
Thank you!