

DUTCH IN-DEPTH ACCIDENT INVESTIGATION: FIRST EXPERIENCES AND ANALYSIS RESULTS FOR MOTORCYCLES AND MOPEDS

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Paper no 236

ABSTRACT

In September 1999 the Dutch Accident Research Team (DART) within TNO Automotive started with the in-depth investigation of traffic accidents. In this paper, the methodology, working procedures and experiences of the team are described and explained in detail. Furthermore, an elaborate description of a European study of Powered Two-Wheeler (PTW) accidents is given: MAIDS (Motorcycle Accident In-Depth Study). Some preliminary analysis results of the Dutch part are shown. Results on accident configurations, accident causes, injuries, collision speeds and helmet damages are presented. The results were also compared with former foreign studies. The preliminary results give interesting insight in some aspects of PTW accidents. Therefore, it can be expected that highly valuable insights can be gained from the project when finalised.

INTRODUCTION

It is commonly known that in-depth traffic accident investigations are an important tool for understanding traffic (un)safety. Currently, the meaning of in-depth investigations only grows, simply because the research questions to be answered by means of in-depth research are more complex. This is related to the fact that much work was done in the field of traffic safety the last few decades, so that further improvement can only be gained in smaller and less straight forward steps.

Large experience with this in-depth research exists in various countries world-wide [1,2,3,4]. Most of the research teams have a different approach, varying from retrospective to immediately on-the-scene methods, and from special purpose research to general investigations of all accidents that occur in a certain region.

It is striking that in-depth research is by far not performed in every country. In The Netherlands, no in-depth studies were performed except for a feasibility study in the seventies [5]. Because of the

above-mentioned reasons that more in-depth knowledge of traffic accidents is necessary, TNO recently started in-depth investigation activities. Specific reasons for in-depth accident investigation in The Netherlands are the fact that the Dutch traffic situation is very specific:

- high traffic density,
- typical road lay-out, especially the separate bicycle and mofa (moped) lanes,
- high number of bicycles,
- many heavy duty trucks related to mainport Rotterdam.

The in-depth research is performed by the DART (Dutch Accident Research Team). Two main goals for in-depth research can be distinguished: first to propose measures for the improvement of traffic safety and second to monitor measures in general once they are introduced for their actual benefit. The second goal is the reason why in-depth activities should be performed for a longer period in time (as seen for other foreign teams). This is also planned for the in-depth activities at TNO Automotive.

The working procedures and methodologies of DART are described in the next section. After that the European project on Motorcycle Accident In-Depth Study (MAIDS) will be explained. Then some preliminary results for the Dutch part of MAIDS will be shown. After that some conclusions will be drawn and an outview to the near future will be given.

INVESTIGATION METHOD AND CO-OPERATIONS IN THE NETHERLANDS

In the beginning of 1999, the start was made with the set-up of the in-depth investigation team in The Netherlands. It was decided that the investigations would be performed according to a *later-on-the-scene* method. This means that the scene of the accident is visited, but only within a reasonable amount of time. This time is typically one hour to 24 hours after the accident. It is important that the scene of the accident is investigated because the

environment or road lay-out is very often a contributing factor to the accident and the inspection of the scene enlarges the understanding of the important accident details.

Another important reason for choosing the *later-on-the-scene* methods is that a team that is permanently standby is less cost-effective. Of course somewhat more details of the accidents will be recorded, but very often the victims or the vehicles are moved well before even the police arrives. Furthermore, the vehicles are towed away very quickly nowadays, so that the vehicles must be traced in many cases anyway. This certainly holds in the dense traffic of the rush hours, where clearing the road way has a high priority in The Netherlands.

Preparations and Privacy

Formal permission for this kind of research was asked for at the Dutch Ministry of Justice and the Ministry of Health. The former only gave its authorisation once the research questions and procedures were written down in minute detail.

Dutch Privacy laws are rather strict and becoming only more restrictive. This is especially related to the European guidelines that were developed in 1995 and the increasing number of possibilities in current data transmission traffic. Therefore, TNO Automotive only obtained permission for the approach of victims if the first contacts were made by the police. In practice this means that first a letter is sent by the police to the victims in which is asked for their willingness to co-operate with the research. Written permission of the victims is required before their medical can be obtained.

Police Contacts and Notification

For the in-depth investigations an extensive network was set up. Contacts were made with the police in two regions in the western part of The Netherlands: in the surroundings of The Hague and Rotterdam, see Figure 1.

The region contains many urban areas, with some of the busiest highways in The Netherlands. Nevertheless, the accident profile in the sampling region coincides rather well with the national accident profile in the whole country. Only the percentage of accidents on secondary roads was approximately 10% smaller than the number on national level and the percentage of accidents with passenger cars was slightly lower, mostly at the cost of the accidents with vulnerable road users in general. The other characteristics of the accident profile were only differing a few percents. These



Figure 1 Sampling region Dutch Accident Research Team (DART).

slight differences are unavoidable at choosing the sampling regions, because every region has its own characteristics. The coinciding of these profiles should remain checked on a regular basis to prevent possible misleading conclusions based on this data.

The notifications come from a specialised police force in the Rotterdam region and the police emergency room in the region of The Hague. Because of this the accidents in Rotterdam are somewhat more severe than in the other region. Differences between the two regions can be expected anyway, because in The Netherlands the police regions are mostly organised in a different way. Furthermore, the police provides TNO Automotive with a copy of the police report of the accident (if one is made). Last but not least, the police takes care as much as possible that the traces and final positions of the vehicles and persons involved are marked as clearly as possible. In general, the co-operation of the police is of a high quality and their willingness to co-operate is very high.

Hospital Contacts

In the sampling region 16 hospitals are situated. With these hospitals close co-operations are set-up for the collection of the injury information of the victims. Trauma surgeons of all the involved hospitals assist with the identification of the injuries. The injuries are coded in AIS, the international standard in this field. With one of the principal trauma surgeons of a academic hospitals

in the region a closer co-operation was set up in order to incorporate more medical expertise in the investigation team.

The Team

The team is part of the Research and Development (R&D) section of the Crash Safety Centre of TNO Automotive. Thus, much use can be made of existing knowledge within TNO Automotive on crashes in general, injury biomechanics, modelling techniques and vehicle dynamics. Also close contacts are set up with other TNO institutes concerning human factors and long term effects of traffic accidents.

At the moment, the team consists of 4 persons fulltime permanent staff and 6 part time flex workers (that coincide with approximately 3 to 4 full time equivalents). Apart from that consultants are connected or closely related to the team, i.e. in the fields of trauma surgery, vehicle dynamics, injury biomechanics and human factors.

Sampling

Depending on the research project, every n -th accident is investigated (with n fixed, but varying per project). This parameter n is at least constant for 24 hours. It depends on the capacity of the research team but also the number of accidents aimed at. However, the decision whether an accident is investigated or not also depends on the quality of the marks and traces that are present on the scene. Accidents with lacking information or traces will be immediately dropped.

Current Status

The in-depth accident investigation activities in The Netherlands are performed since September 1999. The current research is focussed towards three main categories: powered two-wheelers (PTWs), passenger cars and heavy trucks. Firstly, 200 accidents with PTWs have to be investigated for a European project MAIDS (Motorcycle Accident In-depth Study). PTWs are motorcycles, mopeds and mofa's. Mofa's are less powered mopeds, for which often no helmet is required (also in The Netherlands). This project is described in detail in the next sections. Secondly, accidents with passenger cars are investigated for another European project EACS (European Accident Causation Survey). Thirdly, a project on the accident analysis of heavy trucks is currently set up. For this project European harmonisation of in-depth analysis of heavy truck accidents is aimed at. Finally the DART is also involved in a project in which city tram accidents are going to be investigated.

The total number of accidents investigated is given in Table 1. As can be seen, approximately one out of three notified PTW cases is investigated.

Table 1.
Status accidents collected at the Dutch Accident Research Team (DART) of TNO Automotive in NL

# PTW Notifications	620
# Investigations started	196
# motorcycles (MCs)	60
# mopeds/mofa's	121
# passenger cars	14
# heavy trucks	1
# Cases finished	59
# Cases rejected	32

Furthermore, Table 1 shows that from the 196 investigated cases 32 (16%) had to be rejected. The main reason for this is that the involved parties did not want to co-operate so that neither information on injuries nor an interview was obtained. This might cause a bias in the results, because occupants that are guilty probably have a tendency to co-operate less. In order to be able to correct for this or at least have insight in this deviation the rejected cases are stored and will be processed as far as possible.

INVESTIGATING MOTORCYCLE ACCIDENTS

Road accidents involving motorcycles are a major social concern. To develop proper counter-measures industry and policy-makers need a clear, detailed and objective analysis of the causes and consequences of motorcycle accidents. In 1994, the International Motorcycle Manufacturers Association (IMMA) published a report concerning Motorcycle Safety [6], in which several aspects of motorcycle primary and secondary safety have been addressed. Concerning the information on motorcycle accidents, the IMMA study pointed out that there was a need for a radical review of the existing accident statistics, with the aim of achieving an internationally harmonised system of collection and analysis [7]. Moreover, the need of the development of in-depth studies in an adequate sampling of countries was highlighted as the most effective way to improve motorcycle safety.

Former Studies Into PTW Safety

In the past also other studies into safety of PTWs were performed. In the early eighties elaborate results of the analysis of motorcycle accidents in the US were published [8]. This concerned 900 in-depth investigations and 3600 police report accidents. It contained a clear description of a typical motorcycle crash and some

recommendations concerning training, conspicuity and protective equipment. The method used is the basis of the method currently used for MAIDS, so results of these studies can be compared relatively easily. Besides that, in Europe studies into PTW safety were performed as well [9,10,11]. Here, also the typical profile of only MC accidents were explained and countermeasures were proposed, such as motorcycle airbags [10] or leg protectors [11]. Also accident data was used as a basis for possible motorcycle crash tests [12].

The information currently available thus comes from either national police reports or from specific studies as mentioned above. These sources are limited in one of two ways:

1. the national police reports are not sufficiently detailed
2. the specific studies are usually limited by their objectives.

In both cases the information is gathered using different methodologies and is not comparable. There is therefore a lack of comparable, detailed analyses from which to develop suitable countermeasures on an international basis.

The challenge is therefore to specify common, internationally applicable methods for conducting in-depth motorcycle accident investigations, which will provide a clear, detailed and objective analysis of the causes and consequences of motorcycle accidents.

The Response

Within the OECD a working group of experts from industry and the major research teams in France, Germany, Japan, Netherlands, United Kingdom and the USA has prepared a Common Methodology based on current best practice.

The Common Methodology includes the following:

1. Sampling requirements
2. Accident data collection: on-scene, follow-up, exposure data
3. Data assembly, accident reconstruction, data synthesis
4. Personnel selection and training
5. Quality control
6. Liaison/co-operation agreements with government authorities
7. Study implementation and scheduling
8. Database requirements
9. Data analysis

The Methodology has been structured so that there is a basic module which all research teams will use, thereby ensuring the comparability of different research projects. In addition, specialised modules have been developed to cover mopeds and helmets:

other such modules are planned. This structure allows a different emphasis and different levels of detail to be researched, according to the interests and budget of the commissioning agency.

In particular, the Methodology has established common methods for the reconstruction of accidents, the analysis of contributory factors and the collection and analysis of exposure data.

Used internationally, this Methodology will provide the necessary broad basis for a clear analysis of the in-depth causes of motorcycle accidents and allow policy development on preventive measures.

Current Developments

The Methodology is already being used by the industry in its 3-year MAIDS project, co-financed by the European Union, in France, Germany, Italy, Netherlands and Spain. A national project in Japan is also using the Methodology. The United Kingdom's national research project uses the Methodology for the motorcycle cases and has extended some of the concepts to other categories of vehicle. Most interestingly, a brand-new team has been established in Bangkok and, after appropriate training, has found that the Methodology works in that context as well.

The expert group has been maintained to co-ordinate and develop the Methodology in the light of experience and to assist any national teams wishing to use it. As part of the activities to support the users of the Methodology, an Inter-Team Workshop has been established to discuss the practical issues arising during the research and a quality assurance system has been introduced for teams which register to participate in International Co-ordination. The first major project to register for International Co-ordination has been the European industry's MAIDS project.

MOTORCYCLE ACCIDENT IN-DEPTH STUDY (MAIDS)

Origins

In 1996, the European Motorcycle Manufacturers Association (ACEM) proposed to the European Commission a comprehensive study on motorcycle accidents. The aim of "Motorcycle Accident In-depth Study (MAIDS)" was:

1. to provide a harmonised system for the accident data collection and analysis, valid in all countries of the European Union;
2. to carry interdisciplinary in-depth investigations of accident cases in a

representative cross-section of European countries through a network of specialised traffic research institutes;

3. to publish the results and to ensure access to accident data for further research and application to safety enhancement.

In order to accomplish these objectives, ACEM participated since the beginning in the OECD - RTR / RS9 - TEG (Technical Expert Group), an international group of experts in accident investigations involved in the development of an agreed international methodology on motorcycle accident analysis.

MAIDS Organisation

As mentioned above, MAIDS needed a representative cross-section of European countries to be identified. On this purpose, ACEM undertook extensive negotiations with several research institutes throughout Europe, identifying 5 countries: France, Germany, Italy, The Netherlands, and Spain. In these countries, the following organisations have been selected: CEESAR (France), MUH (Germany), University of Pavia (Italy), TNO (The Netherlands) and REGES (Spain).

The building of the database as well as the statistical analysis is centralised in Pavia under the control of ACEM and with the co-operation of all the partners of the project. Contributions to MAIDS are also brought by organisations representing riders, insurance companies and road safety organisations.

The general process of MAIDS is subdivided in 4 phases:

- The 1st phase concerned the general preparation of the teams, their training, the agreement of contracts with national and local police authorities and emergency services and the administrative setting up of the project.
- The 2nd phase concerned the implementation of the OECD methodology with training on the field and specific seminars on accident reconstruction and analysis techniques.
- The present phase is the 3rd phase, which concerns the data collection, the database building and quality control at central level.
- The last phase will focus on the global analysis of the database and will be based on a series of research questions, which have been recently finalised. The research questions are focussing on human factors, vehicle characteristics and environmental conditions.

European Peculiarities

In the application of the OECD methodology in the European context, ACEM had to acknowledge a series of problems deriving by European peculiarities. The first problem concerned the regulations protecting individual privacy: not only access to computerised data is regulated at European level, but also each European country has its own set of rules. Therefore, it was necessary carefully to check the compatibility of MAIDS rules with legal obligations in each country. The second difficulty concerned the co-operation of national and local authorities varying among the countries. In France, a change of the data collection area was needed to be able to proceed.

Moreover, it had to be acknowledged that the common methodology sets rules to be applied by one organisation in one area. Because of the national differences existing in Europe, MAIDS was developed in 5 countries using 5 different organisations. Therefore, a harmonised set of procedures had to be guaranteed in order to enable all the teams to apply in the same way the OECD methodology in what concerns accident reconstruction and identification of contributing factors. On top of this, a relevant obstacle concerned the collection of adequate case control data: the so-called concurrent exposure procedure. The purpose of the concurrent exposure is to measure the occurrence of a given risk factor in the population of accidents and in reference population. This allows verifying whether the said risk factor has a really statistically proven impact on accident causation or severity. Due to practical constraints existing in Europe, MAIDS was prevented to use any of the systems indicated by the OECD methodology. Therefore, we had to develop a specific procedure.

MAIDS Contributions to OECD

In order to solve the above-mentioned problems, MAIDS consortium has developed a series of written contributions to the OECD methodology, which are now being included in the same methodology.

The first of these contributions focuses on accident reconstruction. The "accident reconstruction guidelines" is a collective effort to define step by step procedures to be used in reconstructing motorcycle accidents. The involvement of all the MAIDS teams allowed us to bring in the different experience and the tools needed to comply with this task.

The other main contribution was the set-up by the University of Pavia and concerns a new procedure

to collect concurrent exposure data. The OECD methodology provides video registration and interviews of riders on the site of the accident. However, in Europe interviews on site prove unfeasible for legal reasons (MAIDS teams have no right to stop riders for interviews on public roads.). Therefore, the evaluation by means of concurrent exposure of human factors is impossible as well as the evaluation of some mechanical factors from video only. The procedure developed by the University of Pavia focuses on interviews in several petrol stations in the sampling area, which can provide a satisfactory concurrent exposure basis for human and motorcycle factors.

MAIDS Research Questions

A first series of questions has been identified corresponding to priorities set by public authorities (e.g. driving licenses, training, experience, etc.), industry (e.g. tampered vehicles, brakes design, etc.) and other partners.

Furthermore, the practical implementation of the Methodology at the level of the individual team can be seen in the experience of the MAIDS team in the Netherlands.

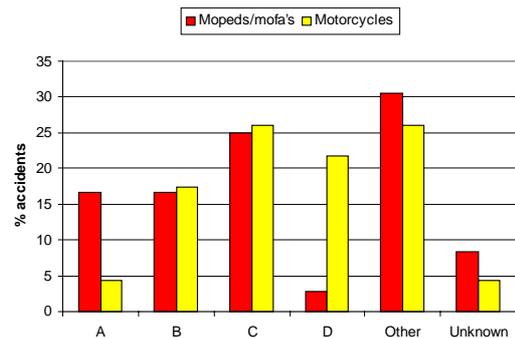
FIRST DUTCH RESULTS FOR PTW ACCIDENTS

In this paragraph some results of the Dutch accident investigations within the framework of MAIDS will be shown. It has to be emphasised that it concerns only **preliminary results**. The reasons for this is that the number of completed accident cases is limited: only 59, see Table 1. Secondly, for a sound statistical analysis the results should be compensated for confounding factors, i.e. factors that are very closely related to other factors. This is not done in this paper. In this section, Dutch results for the accident configurations, the cause factors and velocity and helmet effects are shown. After that the results are discussed.

Accident configurations

First, the accident configurations for the 59 finalised Dutch cases is shown, see Figure 2. The results are presented in percentages of the categories motorcycles, respectively mopeds and mofa's. OV means the Other Vehicle.

The "other" category is rather large. This is related to the fact that for the question involved in the database 20 categories were distinguished. For presentation reasons these were combined as much as possible. Furthermore, it can be learned that the category *OV turning in front of PTW* (either a right



A: Head on collision,
 B: Intersection; perpendicular roads; both straight ahead,
 C: OV turning in front of PTW,
 D: PTW falling on roadway in collision avoidance OV.

Figure 2 Accident configurations of PTWs

or a left turn or a U- or Y-turn) is the most frequent accident configuration for the PTW-rider. Also, it can be seen that for MCs the configuration *falling in collision avoidance with OV* is the second important category, whereas it almost never occurs for mopeds and/or mofa's. The opposite holds for head-on collisions for mopeds/mofa's. In a future analysis, confounding factors have to be taken into account, e.g. OV type and accident causation and crash conditions as in [12].

Cause Factors

An important aspect of accident research is the determination of the cause of an accident. Before this is treated any further, it should be realised that the cause of an accident is sometimes very subjective. If this is not recognised and accepted the analysis could well end up in most *unknown* cause factors, which is of course of no use for any purpose.

Primary Cause Factors - In Figure 3 the primary cause factors are given for the accidents in the Dutch database with motorcycles and mopeds and mofa's, respectively.

It can be seen that for both motorcycles and mopeds/mofa's the most frequent primary accident cause was some failure of the Other Vehicle (OV) driver. In most cases this failure was a perception failure, i.e. the OV driver overlooked the PTW (probably due to a lack of conspicuity of the PTW with rider): in 43 and 25% of the cases respectively. Furthermore, it can be recognised that this accident cause is even much more prominent for motorcycles: in almost half of the MC accidents the OV driver overlooked the MC (43%). Out of the accidents in which the primary cause is an OV driver failure, approximately a quarter of the cases an important contributing factor was a PTW rider unsafe act. This was also the most important

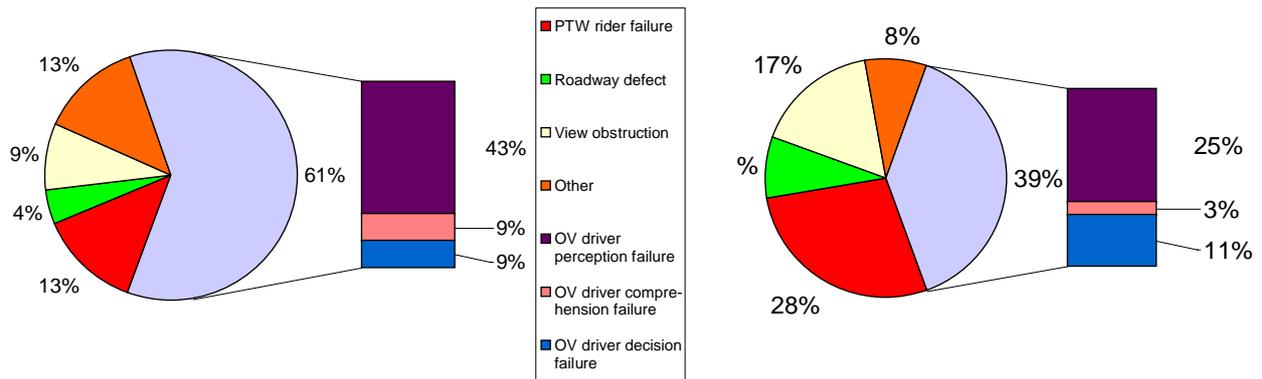


Figure 3 Primary cause factors for motorcycles (left) and mopeds and mofa's (right)

category in the other contributing factors for all PTWs. This means that in spite of the fact that the OV driver was “responsible”, the behaviour of the PTW rider might have been of major influence for the accident as well, e.g. a higher speed than expected by the OV driver. This needs further examination in the near future.

Second most important for both categories is a failure of the PTW rider self. For mopeds/mofa's this cause occurs comparably frequently as a OV driver failure. Another striking result is that neither the weather nor the technical state of the PTW nor the road design seems to be a major accident cause. In a further analysis, the failures of the OV drivers and PTW riders should be further examined, especially conspicuity of the PTW should be taken into account.

Secondary Cause Factors - Apart from the primary cause, it is well-known that most accidents do not have a single cause. They are often the result of a chain of different events. Therefore, it is also interesting to analyse the main other contributing factors. These can be seen as “secondary accident cause”. In Figure 4 an overview is given of the

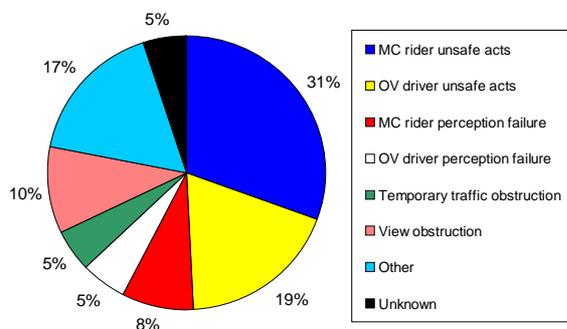


Figure 4 Main other contributing factors for all PTW accidents (or: “secondary cause factor”).

most important contributing factors.

As can be seen, especially unsafe acts from both the PTW rider and the OV rider often contribute to the accident. Further analysis of the primary causes, the influence of the other contributing factors but also other aspects like e.g. the speed and helmet wear rate could further clarify the chain of causes of MC accidents.

The effect of velocity and helmet use on injuries

Helmet use - In The Netherlands it is obligatory to wear a helmet when riding motorcycles and mopeds. For mofa's this is not obliged. For the 23 motorcycle cases all riders wore a helmet during the accident. However, for the 32 moped cases only 75% of the riders wore a helmet, see Figure 5. All of the (4) mofa riders in the database did not wear a helmet during the accident.

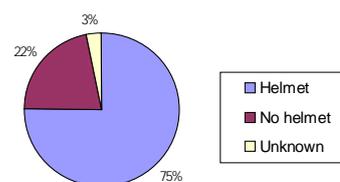


Figure 5 Helmet use rate on mopeds in the research sample (N=32).

Injuries - One of the major advantages of in-depth research is that detailed information is available on the injuries sustained. Furthermore, also information is available on the (relative) collision speeds of the vehicles involved. Below the results are given for the maximum sustained injuries (MAIS) for the whole body (Figure 6) and the head (Figure 7) versus the collision speed of the PTW. It is clear that also the velocity of the OV should be taken into account. For passenger car-to-car

collisions the delta V is mostly used. For PTWs, however, this does not always make sense. In case of a head to tail collision for example, the delta V is almost zero but in case the PTW falls as a consequence of the collision the severity of the accident is more severe than this delta-V suggests. In future publications more realistic accident severity measures will be investigated.

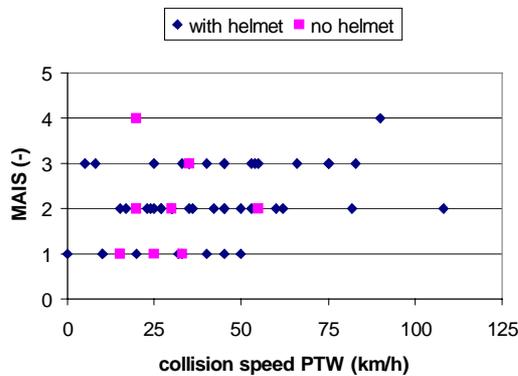


Figure 6 Maximum injury versus PTW velocity.

In Figure 6 it can be recognised that the MAIS has a weak increasing tendency with the delta V of the two vehicles, distinguished for helmet use. Statistically this increase is not significant. This could be influenced by the fact that first the AIS scale is non-linear. Secondly, the correlation deteriorates as a result of the fact that the MAIS is only given in whole numbers. This might also be related to the fact that the collision speed of the PTW is not feasible to describe the accident severity.

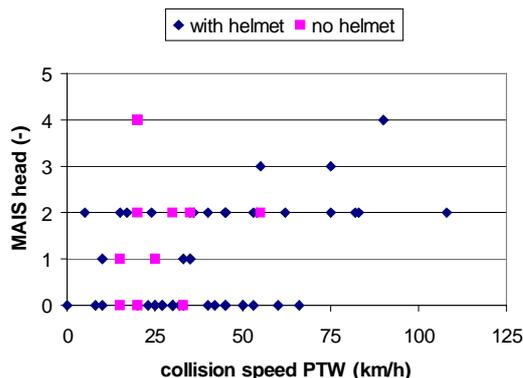


Figure 7 Maximum head injury versus PTW velocity.

In Figure 7 the head injuries are given as a function of the delta V. Also the groups of riders with and without helmet are separated. It can be recognised that the rider group without a helmet shows a tendency to have more severe head injuries than the group with a helmet. It can statistically be shown that the delta V correlates significantly with the

MAIS of the head *if the helmet use is accounted for*. Note that in these results all the PTW riders are combined.

Helmet damage - At last, the amount of helmet damage was investigated as a function of the collision speed of the PTW. This is depicted in Figure 8. For this a subjective scale was developed to describe the helmet damage. This scale is not included in the MAIDS methodology.

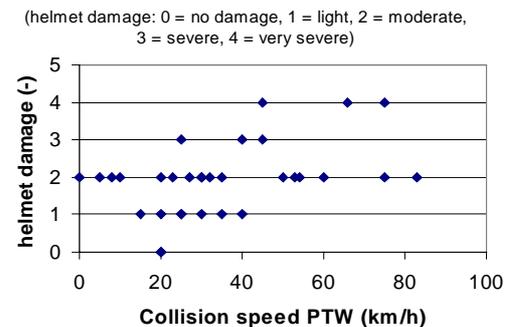


Figure 8 Helmet damage versus delta V of PTW and OV or object.

As for the injuries, the helmet damage seems to have an increasing tendency with the delta V between the PTW and the OV or object. In later studies it should be studied if the helmet actually prevents injury and how the helmet damage correlates with the different types of head injuries.

Discussion Dutch Results

In spite of the fact that the results are preliminary, they still give an interesting insight in motorcycle safety features. As such they can and should be compared with former studies.

Accident Configurations - With respect to the most frequent accident configurations, it can be seen that (in order of importance) “*OV turning in front of PTW*” and “*Intersection; perpendicular roads; both straight ahead*” are the most frequent configurations in the Dutch database for all PTWs. The second coincides with one of the most important crash configurations as given in [11] and [12]. The impact angles are often observed to be less than 45 degrees of either side of straight ahead [8]. It should be investigated in future studies whether or not this is also the case for the most important accident configuration the Dutch results for MAIDS “*OV turning in front of PTW*”. For this, the impact angles and locations on the vehicles should be studied, together with impact speeds.

Accident Causes - The most important accident cause was observed to be some failure of the OV

driver (61% for MCs, 39% for mopeds and mofa's). This is somewhat more than the US findings [8] in which it was stated that this was found in half of the (only MC) cases. Adverse weather and mechanical failures were so far found to be of no importance. This was also concluded for the US in [8]. Also the fact that PTW rider failures were second in importance coincided between the two studies, although this was less prominent in the Dutch study (13%) than in the US (40%). Still in the 60% of the Dutch MC cases where an OV failure was a primary cause, a MC unsafe act was an important other contributing factor in 25% of those cases, which could explain a part of the difference between the US and the Dutch results.

Impact Speeds - Also the impact speeds could be compared for the different studies. This summarised in Table 2.

Table 2.
Comparison of median impact speeds for different accident studies

Study	Median PTW impact speed (km/h)
Hurt [8]	34
Whitaker, see [11]	39
Current Dutch study (N=59)	38
MCs (N=23)	51
Mopeds (N=32)	31
Mofa's (N=4)	19

As can be seen the speeds for MCs in the current Dutch sample are higher than in both other references. This could be due to the fact that the sample is biased somewhat towards more severe crashes. In the near future, also other aspects should be compared, such as injury profiles and damage characteristics such as wheel base shortening, in order to check this possible bias. For all earlier mentioned studies merely the PTW collision speed or the OV speed is taken into account. A more suitable measure for identifying the accident severity needs to be developed.

Injuries - It turns out to be very difficult to determine a correlation between the collision speed and the injuries. In future studies this will be investigated further. For example, other protecting clothing and accident configurations need to be taken into account. A clear result was the fact that the use of a safety helmet had a statistically significant effect on the head injuries sustained. This was also found in many other studies, e.g. [8,9]. Since injuries seem to be not correlated with the collision speed, a safety helmet is advisory for mofa riders as well. Stronger law enforcement of

obliged helmet wearing for moped riders will be beneficial to prevent head injuries.

CONCLUSIONS

To develop proper counter-measures industry and policy-makers need a clear, detailed and objective analysis of the causes and consequences of motorcycle accidents. Increasingly, vehicles and policy solutions are produced at the international level. Accident analysis has therefore to be comparable between countries. The OECD's Common Methodology for Investigating Motorcycle Accidents has been created to meet these needs.

The Methodology has already been used for several projects and shown to be practical and effective in widely different circumstances. In the longer term, the use of the Methodology will also allow comparisons to be made over time, as well as between countries, and this will permit the effects of policy initiatives to be evaluated.

This Methodology is the benchmark for future work in this field. All those interested in the development of motorcycle safety are urged to do whatever they can to help establish research projects which will use the Methodology. In other research areas it will certainly be beneficial as well to establish research projects with world-wide harmonised Methodologies. MAIDS is an excellent example for this.

Conclusions Dutch Statistics

In the previous sections some preliminary results were shown of the Dutch part of MAIDS. A limited selection of some results of only of 59 accident already gave some interesting indications for the causes and influencing variables of PTW accidents. In further studies these effects should be further investigated and cross-checked for possible confounding factors and other influences.

It was shown that in most of the accidents a failure of OV driver seemed to be the primary cause of the accident. Risk taking behaviour of both the PTW rider and the OV driver seemed to be an important contributing factor. Furthermore, it was shown that helmet use has a clear positive effect on the prevention of head injuries. This is also found in numerous other studies. "*Turning of the OV in front of the PTW*" and perpendicular intersection accidents appear to be the most frequent accident configurations up to now.

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