United Nations Informal document No. 2

Economic and Social Council

Distr.: General
1 March 2013

English only

Economic Commission for Europe

Inland Transport Committee

Working Party on Road Traffic Safety

Sixty-fifth session
Geneva, 18 -21 March 2013
Item 7 (a) of the provisional agenda
Consolidated Resolution on road Traffic:
Multidisciplinary crash investigation (MDCI)

Consolidated Resolution on road Traffic

Multidisciplinary crash investigation (MDCI)

Submitted by the Governments of Norway, Sweden and USA

This document, submitted by the Governments of Norway, Sweden and USA, provides guidelines and examples or what to think of when establishing and conducting multi-disciplinary crash investigations (MDCIs). The purpose of an MDCI framework is to identify the direct causes and contributing or underlying factors of an accident and its consequences in order to get enough knowledge for implementing effective risk reducing countermeasures to prevent future accidents or their consequences.

General principles and approaches for Multi-Disciplinary Crash Investigation (MDCI)

Background

1. In 2009 over 1.2 million people were killed in road traffic crashes and between 20 and 50 millions suffered non-fatal injuries. There is an obvious risk that these figures will increase substantially without strengthened efforts and new initiatives, especially if the increasing traffic in the developing countries is taken into account.

2. To be able to take effective countermeasures it is of utmost importance not only to rely on statistical figures and analyses but also on a deeper understanding of the underlying and contributing factors of the road safety problems.

3. One common approach to road safety is mainly based on a premise where individual road users are solely responsible when crashes occur. This view has been enabled by, and is in turn constitutive of, findings claiming that human error is the cause of approximately 70-95% of road crashes.

4. An important contribution to these findings is that accident investigations historically have followed a model based on the assumption that ”human error” caused the mishap. Accident investigations have focused on the personnel closest to the mishap in order to find the “root cause” of the accident. That has lead to the incorrect conclusion that improving road user behaviour is the only effective road safety strategy and hence remedies has primarily been sought in persuading road users to adopt error-free behaviour. Such remedies often consist of legislation, information, education and police surveillance.

5. There is however a growing awareness among traffic safety professionals that a multi-dimensional systems approach is required today to effectively address road safety issues. Instead of focusing on one element of traffic safety in isolation (engineering, enforcement or education), there is a need to build bridges and relationships between all the elements that influence road safety, and to understand how the various elements affect each other at all times. The systems approach focuses on the relationships and dependencies between the various individual elements of the traffic system and the organisational levels which influence those relationships.

6. For that reason there is also a need to engage different competences in the work of investigating road traffic accidents in order to look at them from different systemic angles.

Human error

7. Human error is often defined as unwanted or inappropriate actions leading to an undesired outcome. Broadly, human error models can be categorised as either person models focussing on the errors made at an individual operator level (e.g. driver) or system models focusing on the interaction between wider systemic failures and errors made by individual operators.

The person approach

8. The person approach focuses upon the errors that operators make when operating in the system. Such errors are seen to emerge from psychological factors in individuals such

as aberrant mental processes, including forgetfulness, inattention, poor motivation, carelessness, negligence and recklessness.

9. Error management based on the person approach is focussing on countermeasures aiming at reducing variability in human behaviour through e.g. legislation, enforcement training, education and information campaigns.

The systems approach

10. System approach models treat human error as a systems failure, rather than solely an individual operator´s failure. These models consider the presence of system wide latent conditions and their role in shaping the context in which operators make errors. Unlike the person approach, human error is no longer seen as the primary cause of accidents. Instead it is treated as a consequence of latent failures created by decisions and actions at all levels in a system (e.g. government, local authorities, organisations/companies and their different management levels). In principle at least, the systems perspective approach is now the dominant approach in most safety critical domains where it is often denoted Human Factors or MTO (Man, Technology and Organisation).

11. Current road safety approach in large parts of the world is based on "Vision Zero" or "Safe System Approach", two expressions of an identical policy which is built on a systems approach.

Accident investigation in relation to human error approaches

12. It must be understood that the outcome of an accident investigation and hence the precondition of MDCI to become an effective tool for road safety work is very much depending on the approach to human error. The approach fundamentally forms the basis for the investigation and analysis and hence constitutes which data should be collected. Another important precondition is that those conducting the collection and analysis of accident data and information are competent and understand these working conditions.

The purpose of accident investigation General

13. There is a large number of accident investigation methods described in the literature. All of them are dependent on the purpose of the accident investigation but also on the approach to human error as described above. It is therefore necessary to clearly stipulate these preconditions to be able to choose the "right" investigation method This will not be further elaborated in this paper.

Different purposes

14. A road traffic accident investigation may have different purposes:

- Identify and describe the course of events (**what, where, when**)
- Identify the direct causes/contributing factors of the accident and its consequences (**why**)
- Identify risk reducing measures to prevent future, comparable accidents or their consequences (**learning**)
- Investigate and evaluate the basis for potential criminal prosecution (**blame**)

- Evaluate the question of guilt in order to assess the liability for compensation (**pay**)

15. It is important to note that there is a quite widely spread belief, at least in the legal domain, that the investigations carried out in order to investigate and evaluate the basis for potential criminal prosecution also will increase safety by finding the guilty part in an accident. Contemporary human factors research though clearly shows that this is very seldom the case. It may affect intentional violations but have marginal or no effects on unintentional human errors and mistakes. It must therefore be understood that human error should not be the conclusion of an accident investigation. Instead it should be the starting point since human error is the effect or symptom of deeper, latent conditions in a system.

16. From a strict safety perspective an accident investigation should be a fact finding activity to learn from the experience of the accident, not an exercise designed to allocate blame or liability. The emphasis in conducting investigations should be on identifying the underlying causes in a chain of events leading to an accident, the lessons to be learned, and ways to prevent and mitigate similar accidents or injuries in the future. Hence accident investigation should be used to gather information and data to be able to analyse accidents so that the human and system contributions can be identified. The findings are then used to develop measures to ensure that similar accidents do not occur again or that the consequences of them are mitigated or reduced.

The purpose of MDCI

17. Multi Disciplinary Crash Investigation (MDCI) should be used for identifying the direct causes and especially the contributing or underlying factors of the accident and its consequences from a systems approach in order to get enough knowledge for implementing effective risk reducing countermeasures to prevent future accidents or their consequences.

18. It cannot be stressed enough that the objective of MDCI is to prevent accidents or their consequences – not to apportion blame or liability.

19. For that reason a very clear boundary between MDCI:s and investigations to distribute legal responsibility must be created. If not, there is a great risk that the information flow to the investigators will be seriously hampered if the involved parties suspect that the information will be used for liability matters.

20. It must also be stressed that MDCI is not another or different tool for collecting statistical data about the magnitude of a road safety problem and its prevalence in time and space. Such data is of course valuable for many reasons, e.g. identifying and prioritizing problem areas, but will seldom give any detailed information about the contributing and underlying factors which is necessary to understand *why* the accidents and injuries occur.

21. Instead it is a valuable tool to get a deeper understanding of the underlying accident and injury mechanisms of a limited number of accidents, e.g. a certain type of accidents.

The framework of MDCI

General approach

22. It is important to establish the fact that MDCI is not a detailed accident investigation method. First and foremost it is a general approach to accident investigation based on a systems perspective on accidents and human error which is described above. Hence there is no detailed operational manual for carrying out the investigation. The purpose here is to give some important guidelines and examples of what to think of when establishing and conducting MDCIs:

23. The most paramount question that MDCI should answer is *why* an accident occurred and also, which is important to stress, *why* the consequences became serious. The question *why* must be asked several times, not only on the human level, but also on the technical (e.g. vehicles and infrastructure) and organisational (e.g. organisations responsible for the building and maintenance of infrastructure, professional transport companies and authorities) levels in order to identify latent conditions and contributing factors to the accident and its consequences. It is of utmost importance to understand these conditions and factors in detail in order to be able to *learn* from them and consequently *take effective* countermeasures with a systems approach. It is not enough if the conclusion of the investigation is that the accident occurred because the road user did not follow the rules. Instead it must conclude *why* the road user did not follow the rules and why the consequences became serious. It is first then effective countermeasures can be taken. A brief example:

24. A professional driver is driving his truck 70 km/h. The driver falls asleep and drives off the road. The truck hits a rigid lamppost and the driver is killed. Following questions could be asked:

- Why did the truck drive off the road? Because the driver fell asleep;
- Why did the driver fall asleep? Because he had volunteered to take an extra shift (outside the permitted driving hours) even though he was very tired (he needed the money);
- Why was the driver able to take the extra shift? Because the employer did not have a management system or similar to prevent the driver from driving outside the permitted driving hours. Why didn´t the employer have a safety management system? Because the legislation does not provide that and hence no authority supervision;
- Another answer to the question "why did the driver fall asleep?" could be that the truck was not equipped with a driver alert system. From this answer further questions could be asked which may result in answers showing that vehicle manufacturers do not find economical or other reasons for marketing such devices and politicians or authorities who are not willing to pass laws or regulations stipulating that the manufacturers must install such systems in their vehicles.;
- Why was a rigid lamppost placed in close proximity to the road? Because the regulations governing the design of the road permitted such design;
- Why did the regulations permit such design? Because the road authorities do not have a systematic way of investigating accidents e.g. as a part of a safety management system;
- Why do the road authorities not need a safety management system? Because politicians are unwilling to pass a law which may increase societal costs.

25. What can be learned from this accident is that important contributing, indirect or underlying causes can be found on other levels of the system which imply countermeasures other than ones directed towards the direct causes connected to the actual situation and the road user. Informing, educating or punishing driver will not solve the underlying system problems of rigid lampposts in close proximity to roads, employers not taking responsibility for safety of their drivers and politicians not willing to pass laws.

Basic preconditions for MDCI

Access to information about accident occurrence

26. It is of utmost importance to secure information about occurred accidents. This is particularly important if information and data are going to be gathered on the scene of the accident. Such information can be achieved from the police, emergency services, alarm centres etc. and should be secured by legislation, formal agreements etc.

Access to data sources

27. Further the access to different information and data sources related to the accident which are important for the analysis must be secured. Examples of such information and data are driver´s licence data, vehicle data, infrastructure data (technical data about the road and its surroundings), injury data (hospital data, autopsy reports etc.), rescue data, organisational information (e.g. information about road safety work of the road authorities and buyers and sellers of transports) etc. It is important to establish a long-term accessibility through legislation, formal agreements etc. and not only to rely on personal contacts. When it comes to MDCI there may also be a need for establishing new sources. This depends on which information or data that is needed.

Legal aspects

28. The legal framework in a country may hinder the accessibility to important information for the accomplishment of MDCI. The legislation can be very complex and differ a lot from country to country. Hence it is impossible to give any detailed criteria or advice how to deal with these issues. On a very general level however a piece of advice is the importance of dealing with issues of secrecy and personal privacy. Experiences can nevertheless be found in the operational descriptions from Sweden, Norway and USA in annex I.

Conducting MDCI

Investigation method

29. As mentioned above the outcome of an accident investigation and hence the prerequisite of MDCI to become an effective tool for road safety work is very much depending on the approach to human error. For that reason the investigation method used for MDCI must be based on the systems approach to human error.

30. There are several specific methods described in the literature which are based on such an approach. Some examples are:

- MTO Analysis (Man, Technology and Organisation)
- AcciMap
- STAMP
- FRAM (Functional Resonance Accident Method)
- AEB (Accident Analysis and Barrier Function Method)
- TRIPOD-BETA

31. None of these investigation methods are solely developed for road traffic accident investigations. But in some cases, e.g. the MTO Analysis, they could quite easily be adapted and used for MDCI. The details of the different methods and their usability for MDCI will not be further elaborated.

32. It must also be concluded that the investigation method is not the paramount issue when investigating an accident. Instead it is to apply a systems approach.

Collection of data and information

33. The operational work to gather data and information and practical tools for that work is rather basic and not specific to MDCI. The preconditions in the form of a systems approach, the specific investigation method used and the accident or accident type of interest very much governs which information and data that are of interest. As mentioned above it is though important to guarantee access to the data and information sources.

34. Generally a rather large amount of information and data are needed to cover the different levels of the road transport system in which the accidents occur. Hence it is impossible to present a list of detailed information and data which should be gathered to answer all questions for all types of accidents when applying a systems perspective approach.. For this reason MDCI is not an effective tool for the analysis of e.g. all accidents in a country. The most effective way to use MDCI is probably for thematic analysis of certain accident types which have been indicated by statistical or quantitative analyses.

35. An information source which should not be forgotten is testimonies from people (e.g. involved persons, witnesses and experts) collected by interviews or by hearings. Such information is often important in order to be able to answer the question *why* on different levels of the system.

36. Further the choice and collection of data and information needs to be as unbiased and as objective as possible. Otherwise there is a risk that the assumptions about the nature of accidents guide the investigation, which could mislead the it resulting in that it finds what it looks for.

Analysis

Composition of analysis group

37. As mentioned earlier MDCI is based on a systems approach to human error. This means that there is a need for a multidisciplinary group or team to carry out the accident analysis in order to understand the complex interactions among the components of the transport system leading to accidents and injuries. As a basic requirement the group should consist of at least the following expert competences:

- vehicle mechanics (dynamics and crash properties),
- road design and traffic engineering,
- human factors (HF) and behavioural science,
- medicine (injury mechanisms),
- accident investigation method

38. The members of the analysis group should also have very good knowledge and understanding of the systems approach to human error. They must of course also be as independent and objective as possible.

39. The group may also call on other experts depending on the analysis.

Reconstruct the accident and its consequences

40. To be able to analyse *why* an accident occurred and/or *why* the injuries arose it is important to understand *what* happened. Such reconstruction of an accident must be based on factual findings. There are different practical tools for the reconstruction of vehicle paths etc. on the operational level. But it is almost even more important to reconstruct what happened or rather what did not happen on an organisational level (e.g. road authorities, vehicle manufacturers and sellers and buyers of commercial transports). This must also be reconstructed. Further it is important, if possible, to reconstruct the situation which surrounded or framed the road users´ assessments and actions to be able to understand *why* the road user acted the way he or she did.

Formulate findings and recommendations

41. The analysis group has a responsibility to base their findings and recommendations logically on factual data and information. Findings and recommendations must never be based on speculations. If the group form hypotheses which are not covered by the data material they must consider gathering complementary data and information.

42. The findings and recommendations must further be based on a systems approach to human error. They should therefore be based on the analysis of *what* happened and especially *why* it happened, both from an accident and injury perspectives, on different levels of the system. It means that they principally should be aimed at system countermeasures which have a documented safety effect on accident or injury reduction. Countermeasures aimed directly at the road user in order to correct his or her behaviour should however only be proposed if there is clear proof that they will have a long term safety effect. In most cases their behaviour and errors are only a symptom of systemic problems that other road users may be vulnerable to. The underlying, latent system factors which shape the behaviour or contribute to the injury outcome will still remain in the system. It must also be noted that countermeasures “higher up” in a complex, dynamic system often are more stable or resistant to different pathways to accidents.

Learning from MDCI

43. As mentioned earlier the point of MDCI is to learn from failure. But one of the most difficult challenges is to spread the lessons learned and get the recommendations implemented in reality and followed up by different stakeholders and organisations in the road transport system. It is not enough to write reports and spread them quite widely to these stakeholders and hope that they will get the message and consequently act according to the recommendations. The learning must in some way be integrated or internalized in a systematic way in an organisation. This means that there has to be some kind of learning culture in the organisation and preferably learning also should be an integral part of a quality assurance system or safety management system (e.g. the newly established ISO 39001, a management system standard for road traffic safety).

44. Probably the most effective way of learning from MDCI is if an organization (e.g. a road authority responsible for designing, building and maintaining road infrastructure) carries out own MDCIs: as a part of a safety management system.

45. In the railway area in Europe, legislation stipulates that infrastructure providers and railway companies must have a safety management system of which investigation of accidents and incidents is an integral part.

46. It could be considered to impose such legislation for important stakeholders also in the road transport system.

47. In several countries there are specific accident investigation authorities which objectively investigate accidents in different areas of society. These authorities often issue recommendations which at least other public authorities must implement and follow up.

48. Another less legal way to learn from MDCI is to gather different stakeholders, both private and public, to discuss the analysis and findings of a certain accident or type of accidents and how they can contribute to different countermeasures within their field of formal or informal responsibility.