The Dutch Conflict Observation Technique (DOCTOR)

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1. Introduction

Road accidents constitute an important negative aspect of the quality of the traffic process. A number of different approaches are employed to try and reduce the extent of this problem. In the past it was attempted to blame one single main cause in the traffic process as being responsible for road accident occurring. Road accidents are generally, however, the result of a chain of events. During recent years one can observe a movement towards a practical problem-oriented, and more integral way of thinking and operating. This (dynamic) system approach is being made increasingly applicable for the analysis and control of road safety.

There are two central matters in this approach:

- process analysis in phases aimed at searching for the critical chain of events, or rather the critical chain of risk factors;
- control analysis of the process phases, aimed at the consideration of possible measures until the most effective combination of measures has been found.

The pre-crash phase of accidents nearly always escapes the researcher's observations. This hinders the analysis of road safety. Historical data on accidents that have already occurred is often used. One tries to explain their occurrence using reconstructions. Such reconstructions are only partially possible because the available information about the accidents is incomplete and subjective.

An alternative to this method is to study traffic behaviour, and especially that behaviour which is considered to be dangerous. The most widely used in the study of conflict behaviour. The assumption in that many accidents will occur in those situations where a great number of conflicts occur. The number of registered conflicts is often used as an indicator of road safety. When analysing conflict behaviour it is also of importance to pay attention to the difference as well as the agreement between the numbers of accidents and conflicts. When does a conflict result in an accident? When can an accident be avoided? In other words, which aspects of behaviour under which circumstances determine the severity of a conflict? The conflict is not only used as an indicator of safety but moreover as an unit of analysis for safety analysis in explaining the safety situation. Which behaviour results in which conflicts and given a particular conflict, what is the chance of an accident?
2. Conflict analysis

Conflict behaviour is a type of risky traffic behaviour. We talk of risky traffic behaviour or traffic risk if that traffic behaviour occurs in a situation where it can have negative consequences, particularly injury.

The main consideration with risk is the choice of the road user from a number of behaviour alternatives in relation to the behaviour of other road users. How great is the chance that certain types of behaviour result in an undesirable chain of events that ultimately lead to injury or material damage? How do conscious and unconscious choices in behaviour come about in these situations? Risk control is linked to the control of such choices in behaviour. We can study the various types of behaviour which occur in reality in combination with the behaviour of other road users and attempt to trace which combinations of behaviour lead to fatal events. Such combinations may be described as conflicts. The greater the chance of a serious accident, the more serious and therefore dangerous the conflict will be.

The essence of the usefulness of the conflict method does not lie, as is often erroneously maintained, in the forecasting of accidents but in pinpointing dangerous situations. It is often unrealistic to forecast the number of accidents because, statistically speaking, accidents are rare. The point is to estimate the chance of an accident and to indicate which types of observed conflict behaviour contribute to an increase in the chance of accidents and their severity. There is, therefore, no fundamental difference between general road safety research and conflict analysis as far as confirming a theory of risky traffic behaviour is concerned.

3. The DOCTOR Technique

The conflict method is already being used in a number of countries in a wide variety of real life situations. Under the auspices of the ICTCT (International Committee on Traffic Conflicts Techniques) an international calibration study took place in Malmö, Sweden in 1983 in order to compare the then existing techniques, using individual observers (Grayson [ed.], 1984). A comparison with objective data, obtained from a quantitative analysis from video (Van der Horst, 1984), indicated that observers severity scores were mainly correlated with time-to-collision and conflict type. On the basis of the information and experience, as gained from this calibration study as well as from earlier applications of other conflict observation techniques in the Netherlands (Güttinger, 1980; Van der Horst, 1984; Hyden, 1983) the Dutch technique DOCTOR was developed by the Institute for Road Safety Research SWOV and the TNO Institute for Perception. This development was started because most of the existing techniques were designed for local situations which often differ from those in the Netherlands. With DOCTOR it is attempted to combine the advantages of the other techniques, especially with respect to the Dutch circumstances. Our aim was to develop a technique which can be used under many circumstances, is methodologically sound, and which can be applied in a controlled way.

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1DOCTOR: Dutch Objective Technique for Operation and Research.
Because of the problems of a large scale application of an objective measuring technique (quantitative analysis of video tapes [see Van der Horst, 1982]) the use of observers has to be accepted. Observers in the field are scoring certain traffic situations as a conflict according to a standardised procedure. The DOCTOR observation sheet is given in the Appendix.

In DOCTOR a conflict is defined as a critical traffic situation in which two (or more) road users approach each other in such a way that a collision threatens, with a realistic chance of injury or material damage if their course and speed remain unaltered. If the available space for manoeuvre is less than that needed for normal reaction there is a critical traffic situation. In order to classify the danger, involved in a conflict situation, the severity of a conflict is scored (on a scale from 1-5), considering a) the probability of a collision and b) the extent of the consequences if a collision had occurred. In the following these two dimensions will be discussed in some more details.

Probability of a collision
The probability of a collision is determined by the "time-to-collision" (TTC) and/or the "post encroachment time" (PET). The TTC is defined as the time remaining until two road users on a collision course will collide if course and speed remain unaltered. As long as the road users are on a collision course TTC is a continuous function of time, an example is given in Fig. 1. The lowest value of TTC which is attained during the approaching process is indicated as TTCmin. TTCmin describes the ultimate result and is a good indicator of the maximum probability of collision which can occur at an encounter. The lower the TTCmin, the greater the chance of collision. In urban areas, generally speaking, only a TTCmin of less than 1.5 s(egonds) constitutes a potentially dangerous situation.

![TTC Curve Example](image)

**Fig. 1** Example of a TTC curve as a function of time (lower part) and the difference between TTC at the moment an evasive action (braking, see upper part, $V =$ speed) is initiated and the minimum TTC value.
The concept of TTC requires a collision course. However in cases that road users just miss each other at high speed without considerable course or speed alterations there is, strictly speaking, no collision course. Still there is a realistic chance of a collision under such circumstances, i.e. a slight disturbance of the process will easily result in a collision. The PET provides a measure for this. It is defined as the time between the moment that the first road user leaves the path of the second and the moment that the second reaches the path of the first (Fig. 2). The PET consists of just one value which indicates the extent to which they missed each other after the intersection. Here also applies: the lower the PET the more likely a collision would have been. In general only PET values inside built-up areas less than 1 s are experienced as possibly critical. In DOCTOR the observers give their estimate of TTCmin or PET on the observation sheet (Appendix).

\[ \text{PET} = t_2 - t_1 \]

**Fig. 2 Definition of PET; post-encroachment-time.**

**Extent of the consequences**

The extent of the consequences if a collision had occurred (injury and/or material damage) is mainly dependant on the potential collision energy and the vulnerability of the road users involved. Factors which influence these aspects are: the mutual difference in speed, the available and necessary space for manoeuvre, the angle of approach, the type of road users, etc. The mass and manoeuvrability of the vehicles are the most determinant. In order to estimate the extent of the consequences in the case of a (hypothetical) collision, a comparison must be made between the space for manoeuvre normally necessary to be able to react during such encounters (e.g. anticipatory braking with a normal, comfortable deceleration) and the space for manoeuvre actually available at the moment evasive action is initiated. In critical situations this difference will often be negative. The size of this difference together with the types of road users (among others: mass and vulnerability) determine the extent of the consequences. The greater the difference between normal and available space for manoeuvre the more drastic and maybe more complex (swerving as well as braking) the evasive action has to be. Without (extra) reaction from at least one of those involved, a collision will be the result.

To obtain an as unambiguous estimate as possible of the injury severity and for additional information for analysis and diagnosis, several aspects of the conflict are scored or registered on the observation sheet. First it is
important to know the type of road users involved. There are great differences in mass, manoeuvrability, reaction speed, effectiveness of evasive action (required space for manoeuvre) between a bicycle and a car. Given a certain speed and distance, the difference between available and normally needed space for manoeuvring will therefore be less when a cyclist approaches the flank of a car than when the car approaches the cyclist. Furthermore an estimate of speeds (usually at the onset of evasive action) and the type of evasive action are recorded (evasive action or not, controlled or uncontrolled, braking, accelerating, swerving).

The DOCTOR observation form (Appendix) shows how the above-mentioned aspects are recorded.

Observers and training
In order to guarantee systematic and controlled observations it is essential that:
- the subjectivity of observers is reduced by selection and training, and
- a clear description of the method is given in a manual.

The DOCTOR manual (Kraay, et al., 1986) contains a general, theoretical part and a series of practical examples. This latter part, together with video tapes (instruction-, training-, and testtape) of 116 traffic situations is meant to provide concrete insight in the application of the technique and the method of scoring conflicts. Training in the Dutch DOCTOR technique lasts one week and consists of training in the field as well as video training. The observations in the field training are discussed collectively afterwards and evaluated using video tapes recorded simultaneously. The observers are taught which criteria are important for scoring conflicts and selecting severity.

The experience in training different groups of observers is that a selection of candidates is necessary, because of the complex task which is demanded. However, exact criteria for selection can not be given yet.

Analysis and diagnosis
Together with the general data for the locations being researched (road and traffic characteristics such as geometry, road markings, traffic signs, traffic composition, traffic volumes, speeds etc.) the data gathered on the DOCTOR observation form constitute the basis for further analysis.

The way in which the traffic behaviour is analysed depends on the research problem. The ultimate result is a presentation of which forms of unsafe traffic behaviour occur under which circumstances and to what extent. Based on this information a diagnosis can be given. Sometimes measures can be determined, based on existing knowledge and experience. Sometimes it can be derived which kind of a more specific in depth study of road users' behaviour will be needed.

4. Initial evaluation

The first application of the DOCTOR technique took place in Trautenfels, Austria, at a signalised rural intersection within the framework of a second ICTCT calibration study (Kraay & Van der Horst, 1985).
The design of the Trautenfels study made it possible to carry out an initial evaluation of the field scores using the DOCTOR technique. During the three and a half days of observations a total of 167 conflicts were registered by one or more of the six participating teams. The Dutch team, consisting of two observers, recorded the highest number (78).

Afterwards all 167 conflicts were again reviewed from video by the authors. As a result of this second judgement from video 86% were regarded as a 'rightly scored conflict' (Table I). The 11 conflicts incorrectly detected ('false alarm') all had a severity score of 1. This is therefore a question of criteria on the borderline of being a conflict or not.

Table I All 167 registrated conflicts in Trautenfels with the original detection in the field by the DOCTOR technique and a second judgement from video.

<table>
<thead>
<tr>
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<th>DOCTOR field scores</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>conflict</td>
<td>no conflict</td>
</tr>
<tr>
<td>Judgement from video</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conflict</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td>no conflict</td>
<td>11</td>
<td>75</td>
</tr>
<tr>
<td>not possible from video</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>89</td>
</tr>
</tbody>
</table>

Of those conflicts scored by at least one other team (but not by the Dutch team) there were 12 (15%) which by examining the video tapes should have been counted as conflicts. The severity distribution of these conflicts was exactly the same as that of the total number of conflicts. These situations had apparently been missed in the field. A further comparison with quantitative data obtained from the video tapes and with the results of other teams can be found in Oppe (1986).

5. Final remarks

The conflict observation method is being used in the Netherlands in a number of projects usually in conjunction with other techniques as surveys, speed measurements, and accident analyses.

The government has set up a number of subsidized experiments during the past few years such as: the application of experimental measures in 30 km/h zones, school routes and school surroundings and crossing possibilities of busy urban through-roads. Until now these projects have used other techniques such as those mentioned before. At this moment the newly developed DOCTOR technique is applied.
The first impressions of the applications of the Dutch techniques are positive. After a number of applications have been completed a closer look will be taken to see to what extent improvements in the technique can be made. If the conflict observation method is regarded as a method for systematically observing risky behaviour, as part of a road safety theory in which the traffic process is the focal point and not just the accident as a resulting undesirable product, it will be a valuable tool for controlling road safety.

REFERENCES


### DOCTOR OBSERVATION SHEET

**LOCATION:**

**MUNICIPALITY:**

**OBSERVATION PERIOD:**

**OBSERVER:**

**WEATHER:** sun ☀ cloudy ☁ rain ☔

**ROAD:** dry ☑ wet ☐

**DATE:**

**SEVERITY OF CONFLICT**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>slight</td>
<td>severe</td>
<td></td>
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**MIN. TTC**

<table>
<thead>
<tr>
<th>0</th>
<th>0.5s</th>
<th>1.0s</th>
<th>1.5s</th>
<th>2.0s</th>
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<td>0</td>
<td>0.5s</td>
<td>1.0s</td>
<td>1.5s</td>
<td>2.0s</td>
</tr>
</tbody>
</table>

**EXTENT OF CONSEQUENCES**

- small
- great

**CONFlicTTYPE**

road users Nr.1 Nr.2 Nr.3

- car
- lorry, bus
- moped
- bicycle
- pedestrian
- other

**SPEED**

<table>
<thead>
<tr>
<th>0 - 15 km/hr</th>
<th>15 - 30 km/hr</th>
<th>30 - 50 km/hr</th>
<th>50 - 70 km/hr</th>
<th>70 - 100 km/hr</th>
<th>&gt; 100 km/hr</th>
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<td>☐</td>
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**AVOIDING ACTIONS**

- no reaction
- controlled
- uncontrolled
- braking
- accelerating
- swerving

**MANOEUVRE AND PARTICIPANTS**

- A
- B
- C
- D

* PLACE OBSERVER

**REMARKS:**
PROCEEDINGS OF THE WORKSHOP

TRAFFIC CONFLICTS AND OTHER INTERMEDIATE MEASURES
IN SAFETY EVALUATION

8-10-th September 1986.

Budapest