REVIEW OF TRAFFIC CONFLICTS TECHNIQUE STUDIES

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INTRODUCTION

Greatly increased attention has been given to the road-safety problem at the local level in recent years. This has faced road safety research with new problems, however. At the national level, traffic hazards - and changes therein as a result of countermeasures - can be measured by accident statistics.
Traffic hazards in (old and new) residential areas, in the vicinity of schools, on cycle routes in city centres, but also the redesigning of several streets or of entire residential areas, are attracting greater and greater interest. The typical feature of residential areas, for instance, is that traffic accidents are generally few in number and are usually spread throughout the research area concerned. The number of traffic accidents per annum is also small on traffic arteries inside built-up areas, even where there are black-spots.

A different criterion for expressing traffic hazards is that of near-misses and/or serious conflicts between road users. The expected numbers of near-misses or serious conflicts are in any case greater than the numbers of recorded accidents.
The road safety research method based on the study of (serious) conflicts is often briefly known as the conflicts method. It includes the observation of conflicting traffic behaviour and also its analysis, both by means of appropriate techniques.

In particular, the conflicts method can be used for establishing traffic hazards at separate locations, in specific traffic situations, or with respect to road usage in a variety of conditions, in the event of there being no (or only inadequate) information available on road accidents, or if such information is unreliable. Many people concerned with road safety research are of the opinion that research can be carried out in the near future with the aid of the conflicts method, as a substitute for road accident recording and analysis.

Various conflict techniques are at present being developed in a number of countries. In order to interrelate these developments as

effectively as possible, the First Workshop on Traffic Conflicts was held in Oslo at the end of 1977; those engaged in research work in this field discussed the progress of the various developments.

Little is still known about the development and applications of the conflicts method by potential users of this method.
In this literature survey some different methods have been collected, giving a better idea of the possibilities of using them.

In compiling this survey the following steps were taken:
- Retrospective research was carried out in the International Road Research Documentation IRRD covering the period 1975 to June 1977
- An SDI service Selective Dissemination of Information was made on the IRRD file from June 1977 to December 1978
- SWOV documentation from 1975 to December 1978 was checked
- Checks were made of the literature lists in the collected publications (the so-called snowball system).

Subsequently the publications were traced in the SWOV library. If a publication was present the author's abstract was copied. When there was no author's abstract or if a publication was not present the IRRD abstract was used. If a publication was not in the IRRD file but only in the SWOV library without an author's abstract then the SWOV documentation abstract was used.
The type of abstract, viz. Author, IRRD or SWOV, is specified by means of an A, I or S.

AGENT, K.R.

Development of warrants for left-turn phasing

Research Report No. 456
Kentucky Department of Transportation, Lexington, Kentucky, 1976.
30 p.

IRRD 225542 (I)

Warrants for the installation of left-turn phasing were developed. A review of literature was conducted along with a survey of the policies of other states. Field data of delays and conflicts were taken before and after installation of exclusive left-turn signalization. Left-turn delay studies were conducted at intersections with varying volume conditions. Analysis of the effect on accidents of adding a left-turn phase were made. The relationship between left-turn accidents and conflicts was investigated. Other types of analysis concerning gap acceptance, computer simulation, capacity, and benefit-cost ratios were also performed. It was found that exclusive left-turn phasing significantly reduced left-turn accidents and conflicts. Left-turn delay was only reduced during periods of heavy traffic flow. Warrants were developed dealing with the following four general areas: 1. Accident experience; 2. Delay; 3. Volumes and 4. Traffic conflicts.

AL-ASHARI, N.

Alternate methods of examining correlation of conflicts with accidents
Traffic Engineering 46 (1976) 10: 34-36

IRRD 226585 (I)

A conflict study was conducted at five signalized intersections on a two-way roadway in Grand Rapids, Michigan, with five lanes, one being a center lane for left turns. Because of the substantial number of accidents caused by these turns, a left turn phase was added to the signal operation. The Michigan Department of State Highways and Transportation did a before-and-after evaluation study of conflicts and accidents, finding no correlation betwen frequency variations. Two other statistical approaches for a correlation analysis are described here. Method A is a difference in percentage of vehicles not in conflict after going through the intersections. The difference in percentage in the before and after periods will be the increase or decrease in accidents. Method B is a cumulative function of safety improvement ratio. These methodologies show that the reduction in conflict was between 10 and 14 percent, and the total accident reduction was 17 percent. Investigations with larger sample sizes will be necessary to prove that these correlation methodologies are applicable.

ALLEN, B.L.; SHIN, B.T. & COOPER, P.J.

Analysis of traffic conflicts and collisions
McMaster University, Hamilton, 1977. 25 p.

(A)

Parameters intrinsic to the sequence of events leading to vehicle collisions and traffic conflicts are investigated in an attempt to develop a more practical and reliable application of the Traffic Conflicts Technique (TCT).

To accomplish this, video tape sequences of collisions and conflict events were recorded and are analyzed in detail. Preliminary investigations reveal that the common TCT method of brake application is considerably deficient as a descriptive tool. As a result, seven methods of defining a conflict situation are introduced and evaluated.

It is concluded that at least two of the proposed methods will provide a more practical investigative tool with the capability of explaining more about accident occurence than brake applications alone.

AMUNDSEN, F.H.

Nesten Ulykker (Near accidents: development of a registration method and an analysis of the correlation with traffic accidents)
Transport Økonomisk Institutt, Oslo, 1974. 3 p.

(SWOV PB6468 fo) (S)

The purpose of this project has been to: find a practical method for registration of traffic conflicts which may have resulted in accidents; look for a correlation between accidents and number of conflicts; show that situations which result in conflicts are the same which may result in accidents; and evaluate how data about conflicts may supplement traffic accident data.

AMUNDSEN, F.H.

Registrering av trafikkonflikter (Recording traffic conflicts)

Temaserien - Trafikk No. 7
Transport Økonomisk Institutt, Oslo, 1977. 34 p.

IRRD 232467 (I)

The report describes a method of recording situations which could have developed into a near miss or an accident if one or both of the persons involved had not taken measures to prevent the conflict. The method is illustrated by examples.

AMUNDSEN, F.H. & LARSEN, H.O.E.

Traffic conflicts technique; Status in Norway

In: Proceedings of the First Workshop on Traffic Conflicts, Olso, 1977, pp. 34-39.
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12905) (S)

Conflicts are defined and separated into moderate conflict, dangerous conflict and critical conflict. On a junction conflict and accident situations were recorded before and after the installation of a priority traffic sign. In Norway the conflict observation technique is used if there is a doubt of what to do with an intersection.

BAKER, W.T.

An evaluation of the traffic conflicts technique

In: Traffic records, Highway Research Record No. 384, pp. 1-8
Highway Research Board, Washington, D.C., 1972 .

IRRD 203382 (SWOV PB1347) (A)

The traffic conflicts technique, as developed by General Motors Research Laboratories, was evaluated by the Federal Highway Administration in co-operation with the state highway departments of Washington, Ohio, and Virginia. In addition to a field test of the technique, an attempt was made to find whether there is a statistical relation between traffic accidents and traffic conflicts. Conflicts were counted at 392 intersections before improvements were made and 173 intersections after construction of the improvements. It appears that those characteristics of intersections that contribute to accident causation can be more readily exposed by using conflicts than by using conventional accident analysis techniques. This may be especially true at low-volume rural intersections. Because of this ability to provide more precise information, lower cost remedial actions should result.
Correlation coefficients were calculated for bivariate populations of number of conflicts and number of corresponding accidents. The compiled data tend to support a finding that conflicts and accidents are associated.

BAKER, W.T.

The traffic conflicts experience in the United States

In: Proceedings First Workshop on Traffic Conflicts, Oslo, 1977, pp. 59-63
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12908) (S)

Increased interest in application of traffic conflicts analysis at intersections is generated in the U.S.A. The objective of this research is to develop a standardized set of definitons and procedures that will provide a cost-effective method for measuring traffic conflicts. The major question is how well can traffic conflicts predict traffic conflicts.

BERGER, W.C. & ROBERTSON, H.D.

Measures of pedestrian behaviour at intersections

In: Capacity and measurement of effectiveness, Transportation Research Record 615, pp. 54-59
Transportation Research Board, Washington, D.C., 1976

IRRD 230641 (SWOV PB8762) (A)

This research was performed as part of a research project to identify and evaluate intersection improvements for pedestrian safety at urban intersections. Two field studies and a series of field observations were conducted to identify measures and methods that could reliably yield information concerning potentially hazardous pedestrian behaviour at intersections. Both operational measures and conflict measures were investigated. Of 16 behavioral measures that were tested at 120 intersections in the original field study, 7 were retained, refined, and tested in the following field study. These measures showed considerable promise in differentiating the high from the low accident intersection of a matched intersection pair (having similar traffic controls and geometrics). The measures that were developed in this task were to be used in the evaluation phase of the project.

BURGER, W.J.; SMITH, R.L.; QUEEN, J.E. & SLACK, G.B.

Accident and near accident causation: The contribution of automobile design characteristics

Report No. 802714
Dunlap and Associates, Inc., Santa Monica, 1977. 213 pp.

IRRD 235678 (I)

A study was conducted to (1) determine the frequency and severity of driver/vehicle design mismatch problem contribution to accidents and near accidents, (2) relate driver and vehicle characteristics to severity and frequency of problems experienced by drivers, (3) develop and validate the method used to measure mismatch problems, and (4) identify vehicle design countermeasures which would reduce problem frequency or severity. Based upon recommendations by experts, literature reviews, focus panels and preliminary question testing, five direct mail questionnaires were developed and pilot tested on a sample of 800 U.S. government employees. Results were analyzed and a modified questionnaire recommended for a large scale survey of drivers. The questionnaire contained questions on vision, controls, steering, braking, shiffing, and seating. Subsequently, a direct mail survey was conducted by three private institutions which surveyed 10 000 drivers from California and New Hampshire. The 3500 returns citing 1691 near accidents or accidents for various mismatch questions were analyzed by driver and vehicle demographic variables. Results strongly indicate that the survey approach is valid and that driver/vehicle design mismatch problems are not trivial as contributors or causes of accidents. Most frequent and severe problems experienced are vision related, E.G., oncoming headlight glare, window obscuration due to weather, and mirror information and glare. Steering and braking problems were also significant. Driver height, age, weight, sex, experience and exposure, and vehicle age, size (type), and model are uniquely related to specific mismatch problems experienced.

BRYANT, J.F.M.

Intersection conflicts

Report No. 7
Australian Road Research Board, Canberra, 1973. 42 p.

IRRD 223002 (SWOV PB7984) (A)

Commencing with the classical conflict diagrams for T-intersections, fourway intersections and multi-leg intersections, an exhaustive analysis of conflicts between two, three and four vehicles, with and without turning vehicles, is made. Conflict analysis is applied to the evaluation of priority rules, the effects of regulatory traffic control devices and accident analysis. For the latter risk rates are calculated for intersection flows in which turning vehicles are present. Conflict analysis is also applied to the dynamic situation, i.e. when other vehicles not in conflict may nevertheless influence the way in which conflicts are resolved. The study of conflicts in the field is commented on, including observations of intransitive conflicts or conflicts that cannot be resolved by the direct application of priority rules.

CAMENZIND, J.; HÜRLIMANN, F.W. & KÄGI, B.

Konfliktstelle Fussgängerstreifen (Conflict point pedestrian crossing)

Zeitschrift für Verkehrssicherheit 24 (1978) 1 + 2: 14-20 + 52-58

IRRD 308200 (A)

Our investigations have proved that considerable discrepancies exist, with motorists and pedestrians, between knowledge and behaviour, between intend and doing. Psychotherapeutically spoken, in making these circumstances evident, an initial important step has been done towards coping with an unsatisfactory state. The conflict point pedestrian crossing could be taken the edge off if motorists and pedestrians would exhaust better their feasibilities of communication. A great deal of those involved are aware of these feasibilities, however, little use is made thereof so far, in the concrete traffic situation.

Motorists are aware of

- that they have to drive most cautiously while approaching pedestrian crossings,
- that they have to get into visual contact with the pedestrian in good time,
- that they have to regard handsignals of the pedestrians,
- that specific courtesy has to exercised vis-à-vis children, disabled and ages persons.

Pedestrians are aware of

- that existing pedestrian crossings have to be made use of,
- that they have to wait looking both ways before crossing the roadway,
- that they have to get into visual contact with the motorists in good time,
- that they have to give handsignals and wait for the effect of the latter,
- that they must nog get into the pedestrian crossing suddenly.

This knowledge of the traffic participants is no doubt a good precondition for a safe and justifiable behaviour. An efficient traffic safety work should be based on this knowledge, and should assist in transferring it into a concrete traffic behaviour, for traffic knowledge is merely productively applied if it comes to fruition in the everyday traffic behaviour. Even if all problems about the pedestrian crossing have, by a long way, nog yet been solved, the traffic safety work, in transferring traffic knowledge into traffic behaviour, is faced with a permanent task, for which proper strategies and a specifically methodical instrumentarium would have to be determined. In this regard, namely the step form the theory into practical application has not yet been fully performed neither.

CAMPBELL, R.E. & KING, L.E.

Rural intersection investigation for the purpose of evaluating the General Motors traffic-conflicts technique

In: Highway safety, Proc. Second Western Summer Meeting, Salt Lake City, 1969, HRB Special Report 107, pp. 60-69
Highway Research Board, Washington, D.C., 1970

IRRD 51417 (SWOV PA6834, see also PA5682 fo) (A)

A traffic conflict is any potential accident situation. The traffic-conflicts technique developed by General Motors Research Laboratories is a means for analyzing the accident potential of roadway intersections through observation and tabulation of 5 conflict categories: left-turn, weave, cross-traffic, rear-end, and violation. These conflicts occur when evasive action, such as braking or weaving, is necessary to avoid an accident. To date, this technique has been applied mainly to urban intersections. The purpose of this study was to investigate the application of the traffic-conflicts technique to rural roadway intersections.
The technique was found to be flexibel enough to be applied to both rural and urban intersections, and it is the authors' opinion that the traffic-conflicts technique does detect accident potential and that it appears to be a good systematic method for studying and evaluating the accident potential of an intersection prior to development of an accident history. However, more research and experience with the technique will be necessary to establish this as a fact.

CAMPBELL, R.E. & KING, L.E.

The traffic conflicts technique applied to two rural intersections
Accident Analysis and Prevention 2 (1970) 3: 209-221

(SWOV PA8547 T) (A)

A traffic conflict is any potential accident situation. The traffic conflicts technique is a means of analyzing roadway intersections through observation and tabulation of five basic categories of conflicts: left-turn, weave, cross-traffic, rear-end and traffic violation. These conflicts occur when evasive action, such as braking or weaving is necessary to avoid an accident, or when the traffic code at the intersection is violated.
To date, this technique has been applied mainly to urban fourway intersections. The purpose of this study was to investigate the application of the traffic conflicts technique to rural, Y-type roadway intersections with one approach faced by a stop sign.
The traffic conflicts technique, by delineating initial causes of potential accident situations, provides an understanding of the basic causes of accidents at the studied intersection, and should prove to be an useful tool for traffic engineering changes, leading ultimately to a reduction of traffic accidents. The technique was found to be flexible enough to be applied to both rural and urban intersections, and it is the author's opinion that the traffic conflicts technique can be used to define accident potential. However, more research and experience with the technique will be necessary before it can become a quantitative tool.

CIMA, B.T.

Evaluation of freeway-merging safety as influenced by ramp-metering control

In: Evaluation of transportation operational improvements, Transportation Research Record 630, pp. 44-51
Transportation Research Board, Washington, D.C., 1977

IRRD 233595 (A)

The traffic-conflict technique was modified to evaluate the relative safety of freeway merging with and without the use of entrance ramp-metering control. Six types of traffic conflicts were defined for the entrance ramp and acceleration lane: braking on ramp, braking for lead vehicle, weaving around lead vehicle, entering second lane, entering side by side, and entering late. Five conflicts were specified for the freeway lane (merge lane) adjacent to the acceleration lane: weaving around entering vehicle, braking for entering vehicle, weaving around lead and entering vehicles, braking for lead entering vehicles, and avoiding encroaching vehicles. A three-level severity rating (routine, moderate, and serious) was also developed to assess the seriousness of each conflict. An existing ramp-metering control installation was investigated during freeway levels of service c and d. A two-way analysis of variance was performed on the traffic-conflict data by using, as the independent variables, ramp-control condition (on and off) and freeway level of serve (c and d). The study revealed a significant reduction of 11.6 percent in all traffic conflicts when ramp control was activated. Analysis results indicate that acceleration-lane conflicts significantly decreased when ramp-metering control was used. Merge-lane conflicts were found to be related more to freeway level of service than to ramp control. However, merge-lane, multiple-vehicle conflicts and their severity decreased when ramp control was in effect. An analysis of accident records supported these conclusions.

COOPER, D.F.

Traffic studies at T-junctions (I); 3 observations of gap acceptance using television

Paper presented to Second European Congress on Operation Research, EURO II, Stockholm, 1976

(A)

This paper reviews some of the factors which influence gap acceptance behaviour, and reports on observations of traffic at a T-junction. Previous empirical results on the effects on gap acceptance of the age and sex of the turning driver, the speed and kind of vehicle approaching, waiting and delay, and an audience, particularly a police audience, are discussed. Observations at a semi-rural T-junction in Sussex, using CCTV techniques, are described; results relating to the effect of approach speed on crossing gap acceptance, waiting time at the junction, kind of vehicle approaching, and gap acceptance for crossing and merging together, are presented. Results of an experiment in which warning signs and the presence of police were used to influence gap acceptance are noted. The usefulness of the CCTV technique is assessed. Our main conclusions are that drivers turning across a stream of traffic accept gaps of constant distance, irrespective of the speed of the oncoming vehicle, and that warning signs reduced the risk-taking of drivers turning right from the minor road.

COOPER, D.F. & FERGUSON, N.

Traffic studies at T-junctions (II); A conflict simulation model

Traffic Engineering & Control 7 (1976) 7: 306-309

IRRD 222064 (A)

This paper describes a simulation model for assessing accident risk at a T-junction and its use within a large continuing project. The model is based on the concept of traffic conflicts. It is implemented by an event-stepping simulation program in which the movements of individual vehicles are monitored. The events and vehicle interactions are defined. and it is shown how drivers' turning decisions lead to the occurrence of conflicts. Preliminary results from the model are presented, indicating that its general design is correct and that it identifies areas to which effort might be directed in future. It is noted that the level of risk which drivers take at T-junctions can be modified by police activity. Finally, some comments are made on the usefulness of this kind of study within a larger project.

COOPER, P.J.

A method of predicting high accident locations

In: Proceedings of the 1973 Annual Conference of the Roads and Transportation Association of Canada, pp. 270-278
Roads and Transportation Association of Canada, Ottawa, 1973

(SWOV PB5053) (S)

A total of 59 non-signalized intersections in four major cities were examined. At each intersection, in addition to conflicts, measurements were taken of total volumes for each through and turning movement with the average time taken per vehicle to complete the manoeuvre, all violations occuring at the intersection whether accompanying a conflict or not and average through speeds of vehicles.
The concept of traffic conflicts as an accident predictor has much promise in theory but the results of this study did not indicate a very efficient or practical application for conflicts in their present form.
From the results of this study and also those of other previous investigations, it can be said that traffic conflicts are significantly related to accidents. The problem is that, while significant, the level of correlation is generally low and most of the relationship can probably be accounted for by the high dependance of conflicts on traffic volumes.
The fact that the use of conflicts does add something, however small, to the explanation of accident variance, however, is sufficient to warrant the further exploration of this concept. Emphasis should be placed upon a re-evaluation of the conflict definitions in the light of research on driver behaviour and safety and, perhaps even more important, on the improvement and standardization of observational procedures perhaps eventually to the point of ending the reliance on human recorders.

COOPER, P.J.

Predicting intersection accidents; The use of conflicts and other models based on traffic-flow parameters to predict accident experience at non-signalized intersections

Transport Canada, Road Safety, Ottawa, 1973. 96 p.

(SWOV PB6614) (A)

This report describes a study undertaken by the Ministry of Transport in order to evaluate various models for the prediction of accident occurrence at intersections. Variables considered were: traffic volumes, vehicular manoeuver times, traffic conflicts and violations. Significant correlations were found between accidents and conflicts, accidents and intersection approach volumes and accidents as a function of a time-volume exposure index.

While the data tended to support the hypothesis that accidents and conflicts are related, the correlations achieved were not of a high order and it was found that the concept of vehicular conflicts, in its present form, is not likely to result in a viable tool for the analysis of individual intersections. A possible exception to this general conclusion may be in the area of identifying hazard spots within an intersection.

It was found that the best accident predictor models were those based on vehicular volumes. The inclusion of a time exposure factor, while not improving the overall correlation, nevertheless gave indications of explaining some accident variance in situations where consideration of volume alone was insufficient.

COOPER, P.J.

State of the art: Report on traffic conflicts research in Canada

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 22-33
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12904) (S)

Traffic conflicts technique is not yet being used in Canada in an operational role. The goal of the research on traffic conflicts technique in Canada is to develop a technique which will result in a consistent and reliable indication of hazard associated with certain vehicular manoeuvres, traffic control and geometric constraints. The technique must be based on definitons which are presented.

DRAHOS, R.W.; TREAT, J.R.; HUME, R.D. & HUSSEY, S.A.

An analysis of emergency situations, maneuvers, and driver behaviors in accident avoidence

Indiana University, Institute for Research in Public Safety, Bloomington, Indiana, 1975. 300 p.

IRRD 228832 (I)

The specific objectives of this study were to: develop a taxonomy of emergency traffic conflict situations: develop a taxonomy of evasive manoeuvres available to a driver appropriate to each of the above indentivied situations; identify the critical driver behaviours which comprise each of the above evasive manoeuvers available to a driver; determine the probability of ocurrence for each category of emergency situation identified; determine for each category of evasive manoeuver appropriate to each identified emergency situation that was identified above the probability that a driver would successfully avoid a traffic accident by instituting that manoeuver in its given situation; determine for each critical driver behaviour comprising an evasive manoeuver the probability of frequency of occurrence of each behaviour; and state the findings of the project in terms of the required behaviour responses necessary for accident avoidance in emergency situations.

ERKE, H. & ZIMOLONG, B.

Verkehrskonflikte im Innerortsbereich; Eine Untersuchung zur Verkehrskonflikt-technik (Traffic conflict inside built-up areas)
Unfall und Sicherheitsforschung Strassenverkehr Heft 15
Bundesanstalt für Straszenwezen, Bereich Umfallforschung, Köln, 1978.
177 p.

IRRD 307995 (SWOV PB13408) (A)

The method of systematically observing traffic conflicts in order that accident black spots in the street network may be discovered (Traffic Conflicts Technique), which was developed in the U.S.A., was applied to German conditions and tested at three signal-controlled intersections each in two large cities of the Federal Republic of Germany.
For this purpose, the conflict types to be identified were defined for both the intersection area proper and the approach areas. In order to be able to analyze the relationship between accidents and conflicts, a systematic assignment system to link conflicts and their causes was developed for inclusion in the official records of accident causes. Before the field observations were actually started, the persons charged with the job of traffic observation were trained by means of a new training program especially developed for this purpose.
For some traffic situations, the investigation demonstrated relatively close relationships between the types of conflicts observed and the corresponding accidents recorded by the police at the intersections mentioned.

FRANKLIN, M.

Traffic conflict analysis techniques
The National Institute for Physical Planning and Construction Research, Dublin, 1973. 32 p.

(SWOV PB6620) (S)

This report is concerned with a method known as the "Traffic Conflicts Technique" which is being used to provide a measurement of the "accident potential" at an intersection. Conflicts have also been used in studies of driver assessment. Such studies aim to identify the unsafe driver and are relevant to the safety of junctions since drivers have been observed to have many of their conflicts in those locations. This report is not concerned with this type of study i.e. where individual drivers are observed but rather with the type of study where individual locations are observed.

GAARDER, P. & HYDEN, C.

Allgaafas i signalreglerade korsningar (Scramble system in signalized intersection)
Tekniska Hoegskola i Lund, Lund, 1978. 89 p.

IRRD 235958 (I)

The aim of this project has been to cover, as completely as possible, the consequences of scramble. Studies have been made at three sites; one intersection in the town of Eslov (approx 15000 inhabitants) and two in Stockholm (approx 1 mill. inhabitants). At all three intersections, studies were made both before and after the introduction of a scramble phase in earlier conventionally signalized intersections. In each study, measures of risk as well as measures of motor-vehicles and pedestrian delay and passage times were made. Studies of risk were carried out by the use of a conflict-technique, developed at the institution. Through direct observation at the traffic site, by especially trained observers, serious conflicts were registered (a conflict is a narrow-escape, according to a set definition). These conflicts are then, with the help of a developed model, used in an estimation of the risks of personal-injury accidents. Delay and passage times were registered with the use of a so called date-log - universal instrument which registers time-events with an accuracy of 1/1000 second. In the data-log, collected data are registered on a hole-punched tape which can be processed in a computer. To sum up, it can be stated that a very satisfactory accident reduction is achieved for pedestrians when introducing scramble if the percentage crossing while red is low. Simultaneously, however, the passing times for both vehicle and pedestrian traffic through the intersection are increased. Whether the total effect is considered positive or not, depends on how the two components are evaluated.

GLENNON, J.C. & THORSON, B.A.

Evaluation of the traffic conflicts technique

Midwest Research Institute, Kansas City, 1975. 44 p.

IRRD 222531 (SWOV PB8778) (I)

Traffic accidents are the ideal measure of safety for a highway location. But attempts to estimate the relative safety of a highway location are usually fraught with the problems associated with the unreliability of accident records and the time required to wait for adequate sample sizes. For these reasons, the traffic conflicts technique (TCT) was developed as a surrogate measure in an attempt to objectively measure the accident potential of a highway location without having to wait for an accident history to evolve. The TCT was originally developed by the General Motors Research Laboratories (GMR) in 1967. It was conceived as a systematic method of observing and measuring accident potential. Conflicts were defined as the occurrence of evasive vehicular actions and characterized by braking and/or weaving manoeuvers. Based on the positive results of a large investigative study by the Federal Highway Administration (FHWA), reported by Baker in 1971, the TCT has gained popularity as an evaluative tool. The Washington State Department of Highways is using the TCT as a diagnostic tool to determine appropriate countermeasures at high-accident locations. Others have suggested the technique as a priority ranking criterion for programming the order for the implementation of spot improvements, and the FHWA has incorporated the TCT as a research tool into several recent problem statements in its contract research program. This report critically evaluates the state-of-the-art of the TCT and the results of recent attempts to develop a rigorous experimental design using traffic conflicts as the basic response variable to measure the effectiveness of access control techniques at commercial driveways.

GLENNON, J.C.; GLAUZ, W.D.; SHARP, M.C. & THORSON, B.A.

Critique of the traffic-conflict technique

In: Evaluation of transportation operational improvements, Transportation Research Record 630, pp. 32-38
Transportation Research Board, Washington, D.C., 1977

IRRD 233593 (A)

This examination of the utility of the traffic-conflict technique includes an evaluation of previous studies and a discussion of recent results of a federal highway administration (FHWA) study. The FHWA study attempts to develop a rigorous experimental design by using traffic conflicts as the basic response variable to measure the effectiveness of implementing various access-control techniques. Although some of the studies conclude that the traffic-conflict technique is a reliable tool for predicting accident potential. These conclusions are not well supported. The concept of conflict analysis should not be abandoned, however, but a more rigorous data base should be acquired before the reliability and utility of conflict analysis can be assured.

GOELLER, B.F.

Modeling the traffic-safety system

Accident Analysis and Prevention 1 (1969) 2: 167-204

(SWOV PA6112) (A)

A model is needed that can interrelate the full range of relevant traffic-safety activities and predict their consequences in terms of collisions, deaths, injuries, and property damage. This paper develops a conceptual framework for a traffic-safety model and identifies research needed to make this framework into an operational model.

A traffic accident may usefully be conceptualized as progressing through a series of phases, each a process of interaction among many factors associated with the driver, the vehicle, the environment in and outside the vehicle, and chance. Accordingly, the model is formulated as a chain of phases, where each phase has alternative possible outcomes-called situations - which are physically observable and operationally meaningful. (The evasion phase, for example, may result in either a near-miss, or a collision situation.) These situations have clear and apparent relations to accident likelihood or severity: reveal at what points and in what ways the accident chain may be frustrated: and can be measured and expressed as indices of performance. Situations are analogous to the states of Markov chain or the branches of a "failt tree".

The chain of phases comprising the model is separated into its three natural stages. The pre-accident stage consists of four phases: predisposition, initiation, juxtaposition (confrontarion with danger), and evasion. The intra-accident stage consists of a first-collision phase (impact on the vehicle), and a second-collision phase (impact on the passengers). The post-accident stage, for those injured, consists of three phases: initial-treatment, emergency-transport, and primary-treatment.

This study emphasizes the pre-accident stage, the only one in which accidents can be prevented. Focus is on the driver and his vehicle, although he is not necessarily either the chief cause of accidents or the most cost- effective target of safety measures. Based on perception and estimate of and attitude toward risk (subjective danger), the driver continually makes decisions and takes actions that result in either safe or valnurable driving. A driver experiences a vulnerability whenever he incures a hazard and thereby becomes momentarily vulnerable to a potential collision. The vulnerability approach, which describes accident not in terms of their outcomes but in terms of the hazard which initiate them, helps quantify the cumulative effects of many variables that are difficult to appraise separately. Moreover, vulnerabilities occur about 20.000 times as often as involvements in an accident, thus yielding richer data for studying hypotheses about accident causes.

GOOS, J.G.

Slotboomproject; Een alternatief voor de verkeersveiligheid
(Slotboomproject; An alternative approach to road safety)
Verkeersdienst Rotterdam, Rotterdam, 1975

(SWOV PB8189) (S)

The aim of this project in a residential area in Rotterdam is to bring about, by way of alterations in and of environmental factors, a change of mentality in the behaviour of road users in general and drivers in particular, in order to improve the living conditions in residential districts. The research is aimed at four aspects, viz.: number of motorized traffic, number of conflicts between various groups of road users, nature of these conflicts, and speed of motorized traffic. The collected data are presented and analysed.

GÜTTINGER, V.A.

Veiligheid van kinderen in woonwijken; Deel 1: Conflictmethode; operationalisatie en betrouwbaarheid. (Safety of children in residential areas. Part 1: Conflictmethod - operation and reliability) Nederlands Instituut voor Praeventieve Geneeskunde TNO, Leiden, 1975. 41 p. + app.

IRRD 220519 (SWOV PB7893) (A)

The growing need for a rapid evaluation of measures directed to increase traffic safety has led to the development of so-called "conflict techniques". For these techniques the near-accident or the serious conflict are used as a predictor of real accidents. Several studies have confirmed the validity of this concept. The reliability of the methods used - which, incidentally, have a great deal in common - is not very great, thanks to the extremely vague operationalizations of the concept "conflict".
In the study discussed in part I of the report "The safety of children in residential areas" the conflict technique, as it is used in various countries, has been taken as a starting-point. Attempts have been made, however, to arrive at a more reliable method of investigation by means of a better, empirically determined, operationalization of the concept "conflict". A laboratory test revealed that the method thus improved led in many cases to externally and internally reliable results.
In as far as the results were less reliable, they could largely be ascribed to weak points in the instruction, the fact that the observers were not selected, and the lack of actual training. Proper instruction, selection and training of observers would ensure the workability of this method for field studies aiming at assessing and predicting the (traffic) safety of pedestrians.

GÜTTINGER, V.A.

Veiligheid van kinderen in woonwijken; Deel 2: Toepassing van de conflictmethode in een veldonderzoek. (Safety of children in residential areas. Part 2: Application of the conflict method in a field test)
Nederlands Instituut voor Praeventieve Geneeskunde TNO, Leiden, 1976. 106 p. + app.

IRRD 220520 (SWOV PB9444) (S)

The study had the purpose to check the suitability of a conflict observation technique for measuring traffic behaviour. The experiment - the so-called "residential yard" approach - aims at the integration of several sectors in the vicinity of the home which are normally segregated (such as the road, the pavement, green zones, play areas, and flat entrances) so that children may be offered more possibilities for using them. The experiment also involved the integration of the various categories of users - children, adult pedestrians and traffic - whereby the design of the area was used as a means to subordinate the last-mentioned group, vehicular traffic, to the other groups. The idea behind this was - an idea which is shared by others - that the set-up of a residential area should allow confrontations between children and traffic, but that these confrontations should never take the form of serious conflicts.
The results of the two methods of observation (observations of persons and sectors) are fairly consistent. Compared with the results for a more traditionally planned new residential area, the experimental residential area clearly witnessed more confrontations between children and traffic, a finding which was to be expected because of the integration of the two groups.

GÜTTINGER, V.A.

Conflict observation techniques in traffic situations

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 16-21
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12903) (S)

A serious conflict or near-accident is defined as: a sudden motor reaction by a party or both parties involved in a traffic situation, towards the other, with a distance of about 1 metre or less between those involved. With the help of a conflict observation technique it is possible to forecast the effects of measures taken to improve the safety of for instance residential areas.

GÜTTINGER, V.A. & KRAAY, J.H.

Development of a conflict observation technique; Operationalisation, methodological problems and the use of the technique in two field situations in Delft

Institute for Road Safety Research SWOV, Voorburg, 1976. 30 p. + Figs., Tabs. and App.

IRRD 225778 (SWOV PB11675) (I)

Both for logical reasons and on the basis of research it has become clear that urban planning can have a great influence in reducing the number and nature of conflicts between pedestrians and wheeled traffic. Literature research has shown that measures aimed at influencing social behaviour do not have the desired effect on road safety. It is shown that urban planning and infrastructural measures affect residents' behaviour more than statutory codes and attempts to influence social attitudes and behaviour. The main objective of the research is to develop a conflict observation technique which can be used as a reliable measuring instrument in various urban planning designs to establish road users' behaviour. The research was concentrated on children, as they are the most intensive users of the residential area.

HAKKERT, A.S.; BALASHA, D.; LIVNEH, M. & PRASHKER, J.

Irregularities in traffic flow as an estimate of risk at intersections

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 71-86
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12910) (S)

A basic research effort to determine a methodology for objective analysis of traffic behaviour at an intersection is presented.
A methodology is presented to describe the motion of each vehicle, and to determine its travel characteristics. Excessive values of reaction to driving stimuli have been defined and calculated.

HÄKKINEN, S.; NYYSSÖMEN, R. & RAUHALA, V.

Use of traffic conflict technique for estimation of accident potential

In: Proceedings of the 1st International Conference on Driver Behaviour, Zürich, 1973. 8 p.

IRRD 215031 (SWOV PB9136, see also PB6687 fo) (S)

The use of accident statistics as a starting point and criterion of traffic safety measures has many disadvantages and limiting factors. For future research, general standardized observation methods and statistical procedures are extremely important for an international co-operation. A general trend of traffic conflict studies is that accidents, as a criterion of this method, have given very inconsistent results. This may depend on the random nature of accidents and their recording system. Three pilot studies are made on traffic conflicts, traffic conflicts and psychological right-of-way and traffic conflicts and driver alertness. These methods seem to be more reliable and more sensitive for controlling of traffic safety activities.

HANSEN, L. & HYDEN, C.

Hastighetsbegraensning vid skolor (Speed limit outside schools)

Bulletin 18
Tekniska Hoegskolan i Lund, Lund, 1976. 36 p.

IRRD 233066 (I)

The purpose of this project was to study the effects of lowering the speed limits around schools with regard to the safety of the children, and of motorists' choice of speed. The method used, the conflict method, is based on the hypothesis that there is a connection between accidents and situations where accidents nearly happen. Several methods were used for measuring the speed and the intensity of the traffic, and both fixed and changeable road signs were used in the tests. Observations were made before and after the introduction of the lower speed limits. Later, complementary observations were made in order to establish the long term effects. Four areas were selected for the tests, and population density, geographical factors and street characteristics were taken into account. All four tests indicate clearly that the number of critical situations was reduced as a result of the implementation of the lower speed limits, and in regard to motorists' obedience to the lower speed regulations, differences were observed when the various types of road sign were used.

HARRIS, J.I. & PERKINS, S.R.

Traffic conflict characteristics

In: Proceedings Automotive Safety Seminar, Milford, 1978, paper 26

IRRD 50688 (SWOV PA5216) (A)

Traffic conflict characteristics are measures of traffic accident potentials. A traffic conflict is any potential accident situation. Over twenty objective criteria for traffic conflicts (or impending accident situations) have been defined for specific accident patterns at intersections; essentially these traffic conflicts are defined by the occurence of evasive actions, such as braking or weaving, which are forced on a driver by an impending accident situation or a traffic violation. A method of systematically observing an intersection for traffic conflicts has been devised. In two 12-hr observation sessions, it is possible to evaluate completely an intersection; the information obtained is much more comprehensive than that normally available form accident histories. Further, the initial causes of the incidents, which accident records often fail to reveal, are uncovered. Traffic conflict studies use objective criteria to obtain significant quantities of data in short observation periods.

HAUER, E.

The traffic conflicts technique; Fundamental issues

University of Toronto, Toronto, 1975. 28 p

(SWOV PB6467 fo) (A)

The question is posed which are the circumstances for the Traffic Conflicts Technique to generate more reliable accident rate estimates than those obtained from the history of accident occurrence. To provide an answer, expressions for the variance of the expected annual accident rate are derived for both methods. Based on several applications of the Traffic Conflicts Technique by various researchers, the variability of the "accident-to-conflict" ratio is examined. The analytical machinery so created allows provision of answers to the aforementioned question. It facilitates also derivation of guidelines with respect to the conduct of Traffic Conflicts studies. It appears that the Traffic Conflicts Technique can be used to advantage at locations with less than 4 accidents per year or when accident records are not usable. One day appears to be the best duration of a field count of conflicts. Adoption of a narrower operational definition of "conflict" is suggested.

HAUER, E.

Traffic conflict surveys; Some study design considerations

TRRL Supplementary Report 352
Transport and Road Research Laboratory, Crowthorne, 1978. 30 p.

IRRD 231922 (A)

The traffic conflicts technique is a device for indirect safety measurement. It requires at present the conduct of a field survey to count conflict occurrence. On this basis the rate at which conflicts occur is estimated. This report deals with the accuracy of such estimation and its dependence on the design of the field survey.

First, present practice in conflict count duration is reviewed. Next, the relationship between count duration and estimation accuracy is examined. Using data obtained from several sources the daily variability of conflict counts is described. It is concluded that the expected conflict rate varies from day to day. Use of the negative binomial distribution is suggested as appropirate for the representation of the distribution of sample means obtained from conflict studies. On this basis, confidence limits and probabilities of Type I and Type II errors in hypothesis testing are obtained and tabulated. Their use in study design is illustrated by numerical examples.

The marginal increase in estimation accuracy diminishes rapidly as conflict counting time increases. Thus, there is little to be gained by counting longer than three days. This establishes a practical limit to the accuracy with which expected daily conflict rates can be estimated.

HAYWARD, J.C.

Near misses as a measure of safety at urban intersections

Thesis 1971-06
Pennsylvania State University, University Park, Pennsylvania, 1971.
79 p.

IRRD 214268 (I)

Films of dangerous traffic events were taken using the Bureau of Public Roads' Traffic sensing and surveillance system at the intersection of 14th and F streets in Washington, D.C. The dangerous events were observed on real time television monitors and captured on 16 mm film using a time lag device unique to the system. Forty-three sequences were analyzed using a Benson Lehner film reading system, and a computer program was devised to convert the coordinate output from the film reader into motion parameters for the two vehicles participating in the dangerous manoeuvres. Using the velocities and spacings, a measure of the time until collision for each frame was computed. These time to collision values were plotted against time to form a curve which represented the time available to the two drivers to avoid a collision. It was concluded that the minimum value of this curve could be used to separate near misses from other traffic events of some threshold value were adopted as a base for comparison. The value of one second is suggested as the near miss dividing line. The addition of near miss countes as a safety monitoring method to the present method which uses accident counts is discussed and a plan for implementation of the method is outlined. Long range research required to make near misses into a useful diagnostic tool for traffic engineers is discussed and certain approaches suggested.

HAYWARD, J.C.

Near miss determination through use of a scale of danger

In: Traffic records, Highway Research Record No. 384, pp. 24-34
Highway Research Board, Washington, D.C., 1972

IRRD 203372 (SWOV PB1349) (A)

Near-miss traffic events have been considered but not adopted as a traffic safety tool because of the high degree of subjectivity involved with their indentification. A scale of danger may be applied to a traffic event to facilitate objective measurement and subsequent detection of near-miss situations. The unit proposed here for this danger scale is the time measured until collision between two vehicles involved in the unsafe event. This measure, computed from films taken with the Traffic Sensing and Surveillance System of the Federal Highway Administration at an urban intersection, is an adequate unit to rate the danger of almost any traffic event. It may be used to standardize human observer judgment of dangerous manoeuvers and, therefore, make near-miss monitoring a viable alternative to traffic safety determination.

HEANY, J.J.

How to identify dangerous intersections
City Traffic Department, Philadelphia, 1969. 14 p.

(SWOV PB6635 fo) (A)

The technique was developed because of a feeling of need, based on experience in the field of traffic planning, to define the term "dangerous intersection" and to establish an objective means of identification. The method is presently under consideration of the Spot Improvement Program and copies have been furnished, upon request, to the Special Congressional Subcommittee on the Federal Aid Highway Program of the Committee on Public Works which is inquiring into a number of subjects relating to highway safety, design and efficiency.

HYDÉN, C.

Samband mellan allvarliga konflikter ock trafikolyckor (Relations between conflicts and traffic accidents)
Techniska Hoegskolan i Lund, Lund, 1975. 26 p. + app.

IRRD 219727 (SWOV 10757) (I)

The aim of this project is to develop a method for accident-risk measuring by the use of conflict analysis. The basic hypothesis is that, if the degree of seriousness in conflicts might be measures in an objective way, there is a connection between conflicts and actual accidents. In order to study the relation between accidents and conflicts, accident- and conflict data for 50 intersections in the city of Malmö were collected. The preliminary analysis aimed at discriminating factors that influenced the relation between accidents and conflicts. Two factors were found with an absolutely dominating influence, the kind of road user involved and the speed-standard (the mean speed of vehicles passing the intersection). The main possible application area of the method so far is for before and after studies to evaluate the safety effects of different counter-measures.

HYDÉN, C.

A traffic-conflicts technique and its practical use in pedestrian safety research

In: Proceedings of the International Conference on Pedestrian Safety, Haifa, 1976, pp. 1C1-1C8
Michlol-Publishing House, Haifa, 1977

IRRD 229742 (SWOV PB12303) (I)

Pedestrian safety planning lacks basic knowledge of pedestrian risk, behaviour, attitudes, etc. This is partly due to a lack of a useful method for risk-measuring. Accident analysis has proved to be unsatisfactory for many purposes. A valid conflict technique might solve many of the problems. A traffic-conflicts technique has been developed in Sweden. The conflict criterion is based on the time to collision and covers all kinds of traffic conflicts. The recording of conflicts is carried out by human observers using ground-level observation. Reliability tests indicate very strongly that observers record conflicts in a reliable way after 3-4 days of training. The results from validation studies indicate that this technique, based on a criterion that the degree of seriousness should be taken into account, shows a strong correlation between conflicts and accidents. The three primary application areas of the technique are: (a) in-depth analysis of conflicts to evaluate possible countermeasures. (2) evaluation of safety effects through before and after studies. (3) studies of the relation between accident-risk and different explanatory factors. The conflict-technique here mentioned is used in some on-going projects at the department and has provided results used in both federal and local pedestrian safety planning.

HYDEN, C.

Trafiksaekerhetsplanering grundad paa studier av olyckstillbud
(Traffic safety planning based on near accident studies)
In: Vaeg- och Vattenbyggaren No. 11, pp. 37-39
Svenska Vaeg- och Vattenbyggaren Riksfoerbund, Stockholm, 1976

IRRD 226813 (I)

A study of accidents, which often represent only those that have been reported to the police, does not provice sufficient information concerning contributory factors. Examination of potential accident situations, which it is estimated occur about 5000 times as often as accidents causing injury, is much more promising. It is well known that accidents to pedestrians on a non-regulated crossing at a four-way junction occur four times as often when a motorist is leaving the crossing as when he is approaching it. Since potential accidents, which according to definition occur when there would have been a collision between two road users within 1.5 seconds. If one of them had not taken evasive action, take place about 40 times daily at a road junction, observations were made at 120 cross-roads in Stockholm and Malmoe. As a result of these studies, risk curves relating to conflicts at cross-roads have been drawn. Observations were also made of the effect of speed restrictions outside schools. Studies of potential accident situations showed that there was an improvement of 40 percent in safety.

HYDÉN, C.

A traffic conflicts technique for determining risk

Techniska Hoegskolan i Lund, Lund, 1976. 93 p.

IRRD 228557 (SWOV PB12756) (I)

The aim of this project is to develop a conflict technique for the determination of risk. The basic hypothesis is that there is a difinite relationship between conflicts with a certain degree of seriousness and accidents. The following definition is used: a serious conflict occurs when two road users are involved in a conflict situation where a collision would have occured within 1,5 s if both drivers involved had continued with unchanged speed and direction. The time is calculated from the moment one of the drivers starts braking or swerving to avoid the collision. The recording of conflicts is made by observers at the traffic site. Studies of traffic have been carried out at a total of 115 intersectiosn in three stages. In each intersection conflict registration has taken place during 7 hours and has been compared with previous accidents causing injury during 7 to 8 years. The analysis shows that the kind of driver and the speed standard type of intersections have a definite influence. The resemblance between the results of the three stages shows that the developed conflict technique offers practical application within the following areas: description of present state of situations involving risk in urban traffic and before and after studies to establish the effect on traffic safety of countermeasures implemented.

HYDÉN, C.

A traffic conflicts technique for examining urban intersection problems

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 87-98
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12911) (S)

A three year project with the aim to develop a traffic conflicts technique which should be useful when studying all kinds of safety problems in urban intersections, is described.

HYDEN, C.; GÅRDER, P. & LINDERHOLM, L.

Samband mellan olyckrisk och olika förklaringsvariabler (Relation between accident risk and different explained variables)
Tekniska Hoegskolan i Lund, Lund, 1978

(SWOV PB13993) (A)

The aim of this project has been to develop a model for describing risks to pedestrians and cyclists under varying environmental conditions in urban traffic, at varying exposure to car traffic.
The project is based on risk studies, using a conflict-technique developed at the Department. Parallel to these conflict-studies, traffic volume counts were undertaken.
The relation between accident risk and exposure was tested by linear regression analysis.
Accident risk is defined as the number of serious conflicts per minute, multiplied by a conversion factor for the relation between serious conflicts and police-reported injury accidents.
As measure of exposure was chosen the square-root of the product between the number of pedestrians or cyclists per hour in a studied flow and the number of motor-vehicles per hour that might get involved in a conflict with the pedestrians or cyclists.
The selection of intersections was primarily chosen for studies where the aim was to calculate conversion factors between serious conflicts and accidents. Due to this, no consideration was paid to the fact that in this project a maximum cover of different geometrical designs was desirable.
The consequence of this is that there are just a few design alternatives for which relations between accident risk and exposure could be satisfactorily established.
The main findings in this project may be summarized as follows:
- Accident risk to pedestrians increases with increased speed-standard and street width
- A median traffic-island decreases accident risk to pedestrians in high-speed intersections

- The zebra-crossing ought to be located less than 2 meters, or more that 10 meters away from the intersection in order to minimize pedestrian risk
- Accident-risk to cyclists increase with increased speed-standard and increased street width
- Cyclists are especially risk-exposed in high-speed intersections where they should give way to intersecting traffic
- A separate left-turning lane reduces accident risk to cyclists
- A traffic-island in the intersecting street reduces accident risk to cyclists in high-speed intersections

HYDEN, C. & LOVEMARK, O.

Traffic safety in the center of Uppsala

In: Pedestrian safety project, NATO-CCMS Report No. 27, pp. 80-100
National Highway Traffic Safety Administration, Washington, D.C.,
1974

(SWOV PB8306) (A)

In this report is presented a practical application of a method to decide travellers' risks of personal injuries through behaviour registration. This method has been developed by the PLANFOR group.

Earlier it was necessery to analyze occurred accidents to be able to describe the risks run by travellers.

The great advantage with the behaviour registration method is the immediate and precise description of travellers' risk which it can give. This is of great importance for the summing up of, for example, the safety effects of a traffic regulation. For a comparable summing up through accident data, there is a need for at last 2 years' accidents.
The fundamental thing about the method is that the risk for personal injuries that travellers are exposed to is directly proportional to the share of serious conflict situations which travellers in a flow are involved in.
Serious conflict situations result from, either an uncontrollable conflict-averting behaviour, or a traffic dangerious behaviour which provokes an uncontrollable situation. In both cases the involved travellers should pass each other at a distance less than one meter pratly depending on means of conveyance and traffic environment type.

The risk for personal injury varies with traffic environment type-traffic situation-means of conveyance (conflict class) and size of the conflict-arousing vehicle flows.

The risk quantity which is a measure of the probability that an accident with personal injuries would occur, can be estimated only on the basis of knowledge about the size of traveller-flows and risk for personal injuries in existing conflict classes. The registration of travellers' behaviour and serious conflict situations is executed through direct observation. The observations must be preceded by a training period for the observers and control studies must be executed before and during the observations in order to get a uniform interpretation of the definitions chosen. Registration of travellers' behaviour is executed with an electronic gauge. The summing up is computer-based. Results from an application of the method are presented in the report. These results sum op the safety effects of the traffic regulation performed in the center of the town of Uppsala, October, 1972, as well as they provide material for the first stage of the up-building of a general behaviour data bank, which will constitute the basis for municipal programs against traffic accidents. Through this method the planning can be based on a precise description of the risks and risk quantities of today, their probable change and precisely defined goals regarding traffic safety. The summing up of the effectiveness of the regulation in Uppsala showed that traffic safety had been somewhat improved for all means of conveyance, an effect which in the first place is dependent on the measures taken in those routes which got an increased traffic flow through the regulation.

The total reduction of risk quantity in the regulation in Uppsala was: pedestrians 5%, cycles 2%, cars 11%, all means of conveyance 5%.

INDIANA UNIVERSITY

An analysis of emergency situations, manoeuvers and driver behaviours in accident avoidance

National Highway Traffic Safety Administration, Washington, D.C., 1975. 285 p.

IRRD 234481 (I)

The report presents the results of a study, the object of which was to perform an empirical analysis of in-depth accident case histories. Two aspects were studied: (1) to analyze events which immediately precede a crash, and (2) to derive driver behavioural requirements for accident avoidance imposed by a high-probability set of events. Particular attention was given to emergency traffic conflict situations which involve more than one road-user and require rapid and unplanned actions to avoid a collision. Subjective estimates of the probabilities of accident avoidance were developed for all feasible combinations of emergency situations and maneuvers.

KRAAY, J.H.

Een conflictobservatietechniek ten behoeve van de verkeersveiligheid in woonbuurten (A conflict observation technique for the sake of traffic safety in residential areas)
Verkeerskunde 26 (1975) 5: 252-254

IRRD 214040 (SWOV PB7060 T) (also available in English) (A)

Researchers suspect that infrastructural measures have a greater influence on traffic safety than the more conventional legal measures, traffic regulations, initiatives in the field of instruction, training and campaigns. The Institute of Road Safety Research SWOV has commissioned The Netherlands institute for Preventive Medicine TNO to develop a conflict observation technique in order to determine the effects of various lay-outs of residential environments on traffic safety. The proposed pilot study in the town of Delft is a very useful instrument to gain experience in handling techniques different from traffic accident analyses. The examination concerns the Buitenhof district of Delft, consisting of two areas. The Gillis area has been designed on the basis of the principle that the entire residential area, including the streets, should be used by playing children and that it should offer possibilities for various activities. On the other hand the Fledderus area has been planned along conventional lines, which implies that neat green beds (not to walk on), footpaths, streets and kerbs have been laid out. A few problems pertaining to the reliability of the conflict observation technique are dealt with in this article.

KRAAY, J.H.

Onderzoek van de verkeersveiligheid van de voetganger (Research on pedestrian safety)
In: SWOV congres Toekomst in veiligheid, Publikatie 1976-4N
Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV,
Voorburg, 1976

IRRD 220552 (SWOV PB9606) (I)

Because there are not enough traffic accidents in residential areas to be used for statistical research, the accident cannot be used in a short range study as a measure of degree of hazard. Another measure is the near-miss or severe conflict between road users. The possible use of such conflict techniques is out-lined. It is known that measures in the field of town planning and infrastructure influence human behaviour in residential areas more than do legal or social measures. It is first necessary to develop conflict observation technique as a reliable mesuring instrument; the technique has been used for the first time in a study to compare traffic safety in two residential areas in Delft which are different in layout.

KRAAY, J.H.

Urban planning, pedestrians and road safety

In: Proceedings of the International Conference on Pedestrian Safety, Haifa, 1976. pp. 3C1-3C9
Michlol-Publishing House, Haifa, 1976

IRRD 229755 (SWOV PB12316) (A)

Mixed traffic in residential neighbourhoods has led to the establishment of residential yards. Residential yards are areas where the space open to the public is designed primarily so that the functions of walking and playing are adequately provided for, and only local traffic is allowed. Since traffic accidents do not occur in sufficient numbers in a residential area for statistical research, it is impossible to use accidents as a criterion of traffic safety for short-term research. In this investigation an attempt was made to give a definition of a serious conflict which would be as close as possible to a traffic accident, would be measurable, and would provide enough serious conflicts to make the problem capable of investigation.
The first part of the research showed that it is quite possible in a test situation to make the developed conflict observation technique reliable. The field research carried out in two very differently planned parts of Delft was the second part of the investigation. The field observations have shown that mixed traffic in the residential yard solution leads to more encounters between children and wheeled traffic than in the conventional neighbourhood, and to more serious conflicts involving children. It is clear that much development work still has to be done before the object of the research has been achieved, i.e. to develop a reliable and practical conflict technique for predicting accidents.

KRAAY, J.

Strategies in pedestrian road safety research

The voice of the pedestrian (1976) 6: 103-118

IRRD 229206 (SWOV PB12215) (I)

Mixed traffic in residential neighbourhoods has led to the establishment of shared spaces. Since traffic accidents do not occur in sufficient numbers in a residential area for statistical research it is impossible to use accidents as a criterion of traffic safety for short-term research. In this paper a definition is given of a serious conflict which would be as close as possible to a traffic accident, would be measurable, and would provide enough serious conflicts to make the problem capable of investigation. It is shown that it is quite possible in a situation to make the developed conflict observation technique reliable, but much development work still has to be done.

KRAAY, J.H.

Integration of mixed traffic in residential areas; General principles and strategies

Institute for Road Safety Research SWOV, Voorburg, 1976. 12 p.

IRRD 233897 (SWOV PB13395) (I)

Since validity in the various investigations is still not very great, it would seem advisable firstly to make a given technique reliable enough (because this is the primary requirement for a measuring instrument) so that it will ultimately improve validity. The foregoing implies that no opinions can yet be expressed regarding road safety if urban planning projects are to be evaluated by means of a conflict technique. By using a conflict technique, reliable information can, however, be obtained on certain kinds of encounter that occur, for instance, in a residential yard (shared space). Since the various conflict techniques have not so far proved reliable or valid in most cases, it is advisable to use them in situations where very few, if any, accident statistics are available or where an initial impression of the situation is required.

KRAAY, J.H.

Pedestrian road safety development and research in The Netherlands

Institute for Road Safety Research SWOV, Voorburg, 1976. 15 p.

IRRD 231131 (SWOV PB12597) (I)

Mixed traffic in residential neighbourhoods has led to the establishment of residential yards. Residential yards (shared spaces) are areas where the space open to the public is designed primarily so that the functions of walking and playing are adequately provided for, and only local traffic is allowed. Since traffic accidents do not occur in sufficient numbers in a residential area for statistical research it is impossible to use accidents as a criterion of traffic safety for short-term research. In this investigation an attempt is made to give a definition of a serious conflict which would be as close as possible to a traffic accident, would be measurable, and would provide enough serious conflicts to make the problem capable of investigation. Much development work has still to be done before the object of the research has been achieved, i.e. to develop a reliable and practical conflict technique for predicting accidents.

KRAAY, J.H. & OPPE, S.

Verkeersconflicten als uitgangspunt voor een methode van verkeersveiligheid; Een overzicht van de mogelijkheden en beperkingen van de conflictmethode (Traffic conflicts as a diagnostic tool for road safety research; A survey of the possibilities and limitations of the conflicts method)

Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Voorburg

Not yet published (A)

The application of traffic conflicts as a diagnostic tool for road safety research still provides some problems in practice. The first requirement is a general definition of the concept "traffic conflict". As well as a summing up of the advantages and disadvantages of the use of the conflicts method in road safety research, the use of different operational definities of the concept conflict is treated. Some remarks on the reliability and validity of the conflicts method follows.

From the current development in a number of countries of different conflicts techniques one may expect that the conflicts method can explain more of the variability in accidents than is possible with traffic intensities.

LIGHTBURN, A. & HOWARTH, C.I.

Study of observer reliability and variability in detection of traffic conflicts; Part II

University of Nottingham, Nottingham

Not yet published

LINDEROTH, V. & RINGHAGEN, L.

Traffic study technique at rural intersections

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 40-46
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12906) (S)

The National Swedish Road and Traffic Research Institute (VTI) has been working with the development of a traffic study technique adapted to rural intersections. The primary aim is to receive knowledge of accident: producing mechanismes working at intersections. It is not measured what is meant by traffic conflicts. In this study traffic conflicts are meant in an ordinary sense as well as situations with low potential for accident risk.

MALATERRE, G. & MUHLRAD, N.

Les conflict de trafic: une technique au service des studes de securité
ONSER, Arcueil, 1976

(SWOV PB12815) (S)

Conflict observation for 8 junctions in urban area's and 4 in rural areas were performed. The seriousness of the conflicts were classified into 5 categories and also noted were: the type of conflict, the type of road users involved, estimation of speed, angle of collision if the conflict would have resulted in a accident. From the results of this study it is concluded there exist a correlation between conflict- and accidentrates; suggestions for improvement of the conflict-observation are given.

MALATERRE, G. & MUHLRAD, N.

Interet et limité du concept de conflict de trafic et quasi-accident dans les studes de securité

ONSER, Arcueil, 1976

(SWOV PB128 16) (S)

Conflict-observations for 8 junctions in urban areas were performed. The seriousness of the conflicts were classified in 5 categories and also noted were: the type of conflict, the type of road users involved, estimation of speed, angle of collision if the conflict would have resulted in an accident.
Comparing the accidents happened at these junctions with the results of this conflict-observation study it is concluded there exist a correlation between conflict- an accident rates and also between conflict- and accident types. Suggestions for improving the conflict-observation are given.

MALATERRE, G. & MUHLRAD, N.

A conflict technique

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 47-58
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12907) (S)

Work on traffic conflicts technique carried out at ONSER since 1973 is taken as the basis for this study which takes also into account other factors which determine the severity of individual conflicts, such as speed, manoeuvres and type of road users involved. Although this conflict technique is primarily designed for evaluation studies and for comparison between various locations in terms of risk, it can also be used in safety diagnoses on hazardous locations.

MAMLOUK, M.S.

Right turn on red; Utilization and impact

Purdue University, Lafayette, 1976. 101 p.

IRRD 231330 (I)

The purpose of this research effort was to investigate the quality of use of righ turn on red in Indiana after one year of allowing the manoeuvre as a basic rule. Attention was given to the study of all factors that might affect the manoeuvre as well as the consequences that might occur as a result of applying it. Data were obtained from 150 signalized intersection approaches scattered over 18 cities. Each approach was observed for four hours during peak and off-peak periods. The study examined the performance of the RTOR manoeuvre and the effect of the manoeuvre on traffic conflicts as well as pedestrians. A part of the study examined left turn on red from a one-way street to another one-way street. The number of vehicles that turned on red at locations where RTOR or LTOR was prohibited was also observed.

MERILINNA, M.J.

Traffic conflicts technique to support accident statistics

In: Liikenneturvallisuus on Tavoitteena (Road Safety in Finland)
Tie ja Liikenne (1976) 7

See IRRD 232504

No abstract available at SWOV

MERILINNA, M.J.

Use of the traffic conflicts technique in Finnish road conditions

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 64-70
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12909) (S)

Results of the described project are analysed to show to what extent the usability of the traffic conflicts technique is believed in and if it will be given any weight in decision making. Final results will also determine if the technique will be regarded useful for traffic conditions on roads in rural areas of Finland.

MINNEN, J. van

Een methode voor de kwalificatie van het voorrangsgedrag op kruisingen (A method for the qualification of the right-of-way behaviour at intersections)
Verkeerstechniek 21 (1970) 9: 469-474

IRRD 61548 (SWOV PA7850 T) (A)

The determination of the amount of hazard at intersections is one of the problems one meets while studying the right of way.
Within the scheme of the investigation it is not always possible to gauge this danger by means of accident recording. This led to the searching for alternative methods such as observation of the behaviour of road-users at intersections.
Observation of the behaviour of road-users at intersections were done by some investigators, p.e. British and West-German researchworkers.
A new method was developed by the Institute for Road Safety Research SWOV, mainly since the existing and common methods were considered to be too concise or too comprehensive. The method of the Institute for Road Safety Research is based on the grading of the right-of-way behaviour into four categories:
1. "good": the right-of-way is given correctly;
2. "interchanged": the road user, entitled to the right-of-way, gives way;
3. "precarious": the road user, obliged to give way, only does so at the latest moment; a slightly critical situations arised;
4. "wrong": the road user, obliged to give way, omits such.
The reviewed method was applied to some investigations of limited size. The results were such, that a further development of the method concerned seems to be desirable.
The perfection ought to be directed in the first place to an improvement of the directions to the observers: well-reproducable results should be possible in all hypothetical circumstances.
Secondly, one should search for the relationship between the grading

of the give-way behaviour and the road traffic hazard.
For the time being, especially the categories "wrong" and "precarious" are assumed to be determining for the road accident risk.
The category "interchanged" can give, among others, indications for the discrepancy between de jure and de facto give-way behaviour.
From the results of the first researches, some remarkable facts come to the fore:
In Antwerp (Belgium), the give-way behaviour of drivers with regard to vehicles, coming from the right, is compared with the behaviour of the drivers with regard to the cyclists and moped-riders coming from the right. In that investigation, explicit differences are noted in the percentage "interchanged", that in the second case appeared to be considerable higher. From the observations could also be deduced that the influence of a tramway still occurs, although the statutory law which equated a tramway with a major road, has already been abolished some years ago.
In Den Helder (The Netherlands) the right-of-way behaviour was observed as a before- and after study, at several intersections without give-way regulations (identical road traffic of the right has the right-of-way) which were altered into major intersections. The more or less favourable trend in which the behaviour altered, turned out to be slightly dependent on the fact whether the new give-way regulation met the dominating character of one of both roads or functioned contradictory.

NÄÄTÄNEN, R. & SUMMALA, H.

A simple method for simulating danger-related aspects of behaviour in hazardous activities

Accid. Anal. & Prev. 7 (1975) 1: 63-70

(SWOV PB11420 T) (A)

An attempt to simulate the closed-loop nature of many kinds of hazardous activities, e.g. driving, was made by means of a dart-throwing game in which the score progressively increased towards the right-hand portion of the target. Just to the right of the area yielding the highest score there were a "near-accident" area and, still more to the right, an "accident" area. The former yielded no score and was assumed to warn the thrower; a hit in the latter was followed by a punishment session, an extra session to be performed immediately after the session in which the accident occurred. The subject knew in advance that upon reaching a prescribed total score the session would be over.
The main result was that the hits had a tendency to move to the right, to the area with higher scores and smaller margins of safety, and that this shift was, every now and then, reset by a hit in the "near-accident" area. These changes apparently reflect corresponding phenomena in the thrower's decision-making, and similar changes presumably take place in decision-making in many kinds of hazardous situations.

OLDER, S.J. & SPICER, B.R.

Traffic conflicts; A development in accident research

Human Factors 18 (1976) 4: 335-350

IRRD 222282 (SWOV PB11985 T) (A)

Accident reports have been the main source of information in road safety research, and they provide the usual base for criteria used in countermeasure evaluation. Certain difficulties in using accident data arise from the time periods required for the collection of sufficient numbers of incidents and from the restricted details available for specific incidents. To overcome these difficulties studies have been made to test the feasibility of directly observing situations where road users are in conflict and evasive actions, successful or unsuccessful, become necessary. These conflict studies show that for a range of rural and urban intersections, conflicts occur frequently, are readily observable, and correlate well with the known longterm accident data. The recurring situations leading to conflicts have been detailed and give information on multiple vehicle involvement, queu position, vehicle paths, and blocking maneuvers. The use of this conflict study technique by traffic and highway engineers and road safety research workers is discussed.

OLDER, S.J. & SPICER, B.R.

Using traffic conflicts to assess the safety of road design elements

In: Symposium on Geometric Road Design Standards, LO-skolen Gammel, Denmark, Part II, Session III, pp. 341-353
Organisation for Economic Co-operation and Development, Paris, 1976

IRRD 219986 (SWOV PB13078) (A)

It is possible to augment information from reported accident records by using records of observed near accidents or traffic conflicts. The development of a technique of study involved defining conflicts in terms of evasive action by one or more of the road users involved and classifying each incident by the severity of such action. Records can be made by observers on site or by analysis of a time lapse cine film of vehicle movements at the site.

Conflicts are many times more frequent than accidents and such a technique can provide more precise and detailed information than accident analyses on hazardous locations and manoevres. This allows easier identification of layout related problems and rapid evaluation of the effect of any change in design on safety.

The results from five site studies show the identification of hazards at certain "at grade" junctions on dual carriageway roads and the effect of traffic signal installation at these intersections; the short term effects of introducing a mini roundabout at a simple priority intersection; an evaluation of the effect of a traffic signal installation at an urban intersection; and the effect of increasing the entry lanes at an intersection possessing a small island roundabout.

OLDER, S.J. & SHIPPEY, J.

Traffic conflict studies in the United Kingdom

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 1-15
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12902) (S)

A brief survey of research into and use of Traffic conflict studies in the U.K. is given. Traffic conflict studies are considered as an intermediate measure of safety which is still under development, and there is considerable recognition of the value of such a technique and support for its development. Future research is presented and discussed.

OPPE, S.

Traffic conflict analysis: A road safety research technique

Institute for Road Safety Research SWOV, Voorburg, 1977. 23 p.

IRRD 231127 (SWOV PB12593) (Also SWOV PB7059 T) (in Dutch) (A)

Based on research results, it is ascertained to what extent traffic conflict analysis can be applied as a method of traffic safety research. It appears from the literature that there is no substantial relation between conflicts and accidents. Traffic volumes probably play an important role with regard to this relation. Better results are gained if only serious conflicts are considered. However, research in this field has been made only on a limited scale. In this connection the problem of the reliability and validity of the measurements is of importance. It is concluded that a great deal of evaluating research still has to be done before conflict analysis can be applied on a large scale. In specific cases, particularly those in which only very few accidents have been recorded or no accident history is available, the application of the technique may be useful. A strategy is proposed to decide between both techniques. It is suggested applying traffic encounters instead of traffic volumes to measure exposure and using that the results of conflicts should be used in combination with other data such as those derived from observations of road-users' behaviour.

OPPE, S.

Some notes on: "What tasks is a traffic conflicts technique intended for?"

Revised version of Contribution to Proceedings First Workshop on traffic conflicts, Oslo, 1977, pp. 111-116
Institute for Road Safety Research SWOV, Voorburg, 1977. 6 p.

IRRD 231128 (SWOV PB12594) (I)

Road safety can be measured by means of accident analysis. Another measuring method is the conflicts technique. The validity of the conflicts technique is related to the reliability of the two measuring methods. A decision procedure is given for deciding between the two methods when the accident history is incomplete. The alternative of combining both methods is described. An example is given of a decision procedure between the criterion varibales traffic volume and accident counts.

OWENS, D.

Traffic incidents on the M1 motorway in Hertfordshire

TRRL Supplmentary Report SR 390
Transport and Road Research Laboratory, Crowthorne, 1978. 11 p.

IRRD 232902 (A)

An on-the-spot study of traffic incidents on the M1 motorway in Hertfordshire during several weekend peak traffic periods gave information on the types of incident, their probable causes and their effect on traffic. Additional data relating to incident clearance, including detection and response times, were also collected. Several problems connected with motorway incidents have been identified, and a number of proposals for further study are included.

PADDOCK, R.D.

The traffic conflict technique: An accident prediction method

Second edition
Ohio Department of Transportation, Columbus, 1974
Also in: Traffic accident analysis, Transportation Research Record 486, pp. 1-10

(SWOV PB4739) (A)

The Traffic Conflicts Technique was developed by General Motors Research Labs as a method of measuring accident potential during the early 1960's. The Technique is based upon tabulation of evasive maneuvers at intersections as evidenced by brake light indications or lane changes. For the purpose of measuring accident potential at intersections, some twenty-odd specific conflict classifications are defined and coded on computer keypunch forms.

As a result of a FHWS financed research program, the State of Ohio became involved in the evaluation of the Conflicts Technique during 1969. At the time that the Federal Program ended in 1971, Ohio decided to pursue its own evaluation of the technique. This decision was prompted by a conviction that the theory behind the Conflicts Technique was sound and a belief that it could be used to find an accident projection technique for use in Ohio.

In order to be useful, an accident projection technique must reflect the accident trends of the subject area. Early tests indicated that the projection algorithm published by FHWA could not be easily calibrated for Ohio data trends. Although Ohio data was utilized in generation of the FHWA method of accident prediction, it was felt that the data from the other states that submitted data, namely Virginia and Washington, was of such volume and different nature as to bias the resulting algorithm away from the accident trends found in Ohio.

During 1972 and the first half of 1973, the Ohio data base was enlarged from 196 projects collected under the FHWA Program to 410

projects, thus providing 992 approaches of data, of which, 611 were usable for analysis purposes. A series of regression models were applied to this enlarged data base in an attempt to find a reliable accident prediction model. As a result of the regression analysis, accident prediction algorithms were developed which provide a mean accuracy of $\pm$ 1.1 accidents per year and a 75 percentile accuracy of $\pm$ 1.8 accidents per year. In addition, substantial insight was gained into the workings of the Conflicts Technique and its underlying theories. With this understanding of the Conflicts Technique and appreciation of the theory of conflicts came new questions and areas for future study. As a result, Ohio intends to continue its use and evaluation of the Traffic Conflicts Technique and hopes to eventually provide the Traffic Engineer with a versatile tool for the evaluation of traffic flow efficiency and accident potential.

PAHL, J.

A comparison of direct and indirect methods for determining accident potential

Accid. Anal. & Prev. 2 (1970) 3: 201-209

(SWOV PA8546 T) (A)

The methods of determining the accident potential of a highway site can be categorized into direct and indirect approaches. Principal advantages and shortcomings of each of these two categories are discussed. A comparison of the two categories leads to the conclusion that there appears to be no advantage in the use of the indirect approaches as long as the relationship between traffic safety and the multitude of factors affecting traffic safety cannot be quantified.

PARSONS, H.M.

Caution behaviour and its conditioning in driving

Human Factors 18 (1976) 4: 397-408

IRRD 222288 (SWOV PB11991 T) (A)

If people drove more cautiously, there might be fewer accidents. Caution behaviour includes pausing and looking. It is suggested that the "precautionary pause" based on a longer response latency and reduced force can be conditioned into drivers as avoidance behaviour. In laboratory research that can be constructed as simulation of driving, latencies were lengthened and forces diminished because of the contingencies of an aversive consequences that generate driver avoidance behaviour, including the precautionary pause. How might the driving environment, including motivational signs, be designed to exploit this process and thereby contribute to highway safety?

PAYMANS, P.J.

Is een bijna-ongeval bijna een ongeval? Een exploratieve analyse van de bijna-ongevallen op overwegen (Is a near-accident nearly an accident? An explorative analysis of near-accidents on railway-crossings)
Universiteit van Amsterdam, Amsterdam, 1972. 84 p.

IRRD 216263 (SWOV PB7687) (I)

1915 so-called near miss accidents on level crossings were counted by railway drivers in 1971. A near miss was defined as the traversing of a level crossing when the safety installation was working or - in absence of this - the traversing when the train according to the judgement of the driver was already very close. With the aid of prediction formula, by which the number of expected accidents on level crossings can be forecasted, it is possible to pursue a policy based on objective safety norms for example regarding the kind of level crossing safety measures.

PERKINS, S.R.

GMR traffic conflicts technique procedures manual

Publication 895
General Motor Research Laboratories, Warren, Mich., 1969. 20 p. + app.

(SWOV PB4309) (A)

The Traffic Conflicts Technique was developed by Research Laboratories, General Motors Corporation, to be a measure of traffic accident potential. A Traffic Conflict occurs when a driver takes evasive action, brakes or weaves, to avoid a collision. The evasive action is evidenced by a brake-light indication or a lane change by the offended driver. Objective criteria for Traffic Conflicts have been defined for over twenty specific accident patterns at intersections. This Procedures Manual defines the methodology to be used in making formal surveys in accordance with the technique.
This Procedures Manual was prepared by Research Laboratories, GMC for the Bureau of Public Roads, Federal Highway Administration, U.S. Department of Transportation.

PERKINS, S.R. & HARRIS, J.L.

Traffic conflict characteristics; Accident potential at intersections
General Motors Corporation, Warren, Mich., 1967

(SWOV PA1953) (A)

Traffic conflict characteristics are measures of traffic accident potentials. A traffic conflict is any potential accident situation. Over twenty objective criteria for traffic conflicts (or impending accident situations) have been defined to specific accident patterns at intersections: essentially these traffic conflicts are defined by the occurrence of evasive actions, such as braking or weaving, which are forced on a driver by an impending accident situation or a traffic violation. A method of systematically observing an intersection for traffic conflicts has been devised. In three 12-hr observation sessions, it is possible to evaluate completely an intersection; the information obtained is much more comprehensive than that normally available from accident histories. Further, the initial causes of the incidents, which accident records often rail to reveal are uncovered. Traffic conflict studies use objective criteria to obtain significant quantities of data in short observation periods.

POWERS, L.D. & ROSENBAUM, M.J.

Traffic sensing and surveillance system experimental installation Washington, D.C.

In: Proceedings of the Collisions Investigation Methodology Symposium, Warrenton, 1969, pp. 436-461
Cornell Aeronantical Laboratory, Inc., Buffalo, 1969

IRRD 200477 (SWOV PA8233) (I)

Two-thirds of all accidents occur on city streets with one-third of all accidents occurring at the intersection of city streets. In addition many of the "nonintersection" accidents can undoubtedly be attributed to operations at intersections. With respect to costs one-half of total accident costs arises from accidents on city streets. One-fifth of all accident costs arises from accidents at city street intersections. The Traffic sensing and surveillance system was developed as part of the urban intersection project. The aim of which is to improve safety and flow at urban intersections. The method used in this system is video cameras and continuous video recording with automatic traffic signal monitoring.

PUGH, D.E. & HALPIN, T.J.

Traffic conflicts in Washington State

Washington State Department of Highways, Washington, 1974. 12 p.

(SWOV PB6469 fo) (S)

The Traffic conflict theory is tested in Washington State and some of the preliminary results are presented. Conflict studies are counted generally at hazardous intersections and an attempt is made to obtain a measure on just how many conflicts per hour should be responsive to a given intersection. The conflict technique is a highly valuable tool for use in the assessment of accident potential.

PYYMÄKI, M.

Tutkimus Liikennekonflikteista; Simulointimallin vertailu ja sovellutus (Traffic conflict simulation model)
Tie-ja Liikennelaboratorio, tiedonauto 29
Valtion Teknillinen Tutkimuskeskus, Espoo, 1975

(SWOV PB13551) (A)

A simulation program developed at the Technical Research Center of Finland, is an attempt to combine two new traffic study methods, simulation and conflict technique. The conflicts are simulated in order to be able to estimate the traffic safety of even those projects still at the planning stage.

A simulation model can at a time be applied to only one crossing or other similar limited place. The structure and the geometry of the traffic network is of free choice. Traffic control may be based on traffic lights or it may not. The traffic flows, inbound traffic's type distribution and the distribution of the vehicular gaps are also a matter of choice. The model function is such, that vehicles try to proceed according to the traffic rules, but observations between them are stochastic. The vehicles may then proceed into situations, where a collision becomes a threat. These are explained as conflicts, wich still can be classified on the basis of the necessary retardation to save the situation.

The simulating model was in 1976 applied to eight crossings in Helsinki, each also being a place for field observations about conflicts. In comparison with the accident statistics the simulated conflicts correlate just slightly poorer than the observed conflicts. The simulation model will be further developed and it may be possible, after some improvements, to apply it for comparison of traffic plans and prediction of accident figures at crossings.
The model puts out the conflicts divided into four groups.

- a vehicle ahead in driving direction or rear-end conflict.
- a pedestrian ahead or pedestrian conflict.
- a vehicle under obligation to yeld drivers in the way from the left or right-of-way conflict from left.
- a vehicle under obligation to yeld drivers in the way from the right or right-of-way conflict from right.

RUSSAM, K. & SABEY, B.E.

Accidents and traffic conflicts at junctions

TRRL Report LR 514
Transport and Road Research Laboratory, Crowthorne, 1972. 16 p.

IRRD 204874 (SWOV PB1810) (A)

The problem of accidents at junctions, which feature largely in road accidents in Great Britain, is reviewed. An analysis of the national statistics of injury accidents indicates the extent to which accidents feature at different types of junction and the relative risks for different classes and ages of road user. Two techniques developed for studying junction accidents are described: one method assesses the safety of an individual junction by studying the vehicle movements which result in near accident or conflict situations: the other combines accident data for junctions of similar lay-out by location sampling. Examples of the application of these techniques to rural junctions are given and possible remedial measures are considered. The need to extend this work to urban junctions is stressed.

SCHWERDTFEGER, W. & ZIMOLONG, B.

Technische und psychologische Bedingungen der Unfallverhütung in Strassenverkehr

Zeitschrift für Verkehrssicherheit 19 (1973) 3: 143-162

IRRD 301775 (SWOV PB5508 T) (A)

Reflections are defined on a new conception of accident prevention. Related experimental starts are referred to. Proceeding from a critical discussion on the human causing concept a reorientation is proposed considering stronger the situative factors with the occurrence of accidents. It is shown that for methodic reasons the diagnosis of qualification for traffic is not able to effectively contribute to reduction of accidents by the elimination of persons tending to cause accidents. On the other hand the road traffic engineer, in collaboration with representatives of anthroposcientific disciplines, may contribute effectively to prevent accidents, by a stronger regard of the effect of the driving space upon the man's way of acting.

SHIMADA, J.K.

Measures of site hazard - hazardous manoeuvres

Accid. Anal. & Prev. 12 (1974) 6: 309-315

IRRD 214298 (SWOV PB9181) (A)

This paper describes hazardous maneuvers and their possible utilization to evaluate hazard of roadway sites. Some established hazardous maneuvers are erractic maneuvers, traffic conflicts, near-miss and hazardous regions of vehicle pairs.
Hazard is defined as an occurrence function. The possible output consists of a continuous range of manifest severity event-accidents, hazardous and borderline maneuvers. An interval of that range is described by a subfunction of the occurrence function. The imput consists of driver, environment and vehicle (DEV) variables. A random variable is interrelated with the DEV variables in the occurrence function forming complex interactions.
In a comprehensive hazard reduction program, the concept of hazardous maneuvers is only a subset of the total hazard. Remedial techniques would be applied to the DEV variables as suggested by models of occurrence subfunctions and conventional traffic engineering studies.

SPICER, B.R.

A pilot study of traffic conflicts at a rural dual carriageway intersection

TRRL Report LR 410
(Transport and) Road Research Laboratory, Crowthorne, 1971. 26 p.

IRRD 200129 (SWOV PB324) (A)

A study of traffic conflicts at a rural dual carriageway intersection has been made and the relation of conflicts with injury accidents investigated. Simple conflicts, defined as situations involving one or more vehicles taking evasive action, do not correlate closely with reported injury accidents, but serious conflicts, defined as situations involving a vehicle in at least a sudden rapid deceleration or lane change to avoid collision, correlate well with reported injury accidents both in location and time of day. It is shown that more than two vehicles were present in three quarters of the conflict cases studied. Three of the most common situations observed leading to multi vehicle conflicts are described. Speed measurements were made but no evidence was found which indicated that vehicles travelling faster than average were an important factor in the generation of accident situations.

SPICER, B.R.

A traffic conflict study at an intersection on the Andoversford by-pass

TRRL Report LR 520
Transport and Road Research Laboratory, Crowthorne, 1972. 19 p.

(SWOV PB3292) (A)

Further data to validate the use of traffic conflict techniques in assessing junction safety have been collected from a study at rural dual carriageway intersection in Gloucestershire.
As in the earlier study it was found that accident data and data for serious conflicts is correlated well both by time of day and place of occurrence in the intersection. The relative frequencies of various types of conflict (e.g. blocking manoeuvres, overtaking and "follow out" cases) in most cases substantiate those found in the earlier study. Observation of vehicle manoeuvres prior to and during serious conflicts again revealed that vehicles other than the two immediately involved were present in over 60 percent of the cases. Unlike the earlier site the conflict and accident rates at this intersection increased with increasing vehicle flow.
The study of vehicle conflicts at this intersection has led further to an assessment of driver behaviour and other associated factors. These include driver age, crossing time, path taken and vehicle speed.
The investigation provides further justification for the use of the traffic conflict technique and indicates ways in which it can be developed.

SPICER, B.R.

A study of traffic conflicts at six intersections

TRRL Report LR 551
Transport and Road Research Laboratory, Crowthorne, 1973. 15 p.

IRRD 206302 (SWOV PB2566) (A)

Traffic conflict data have been obtained for six intersections using the technique of observation and definition of conflicts established in a previous study at one of the sites. Serious conflict and injury accident frequencies are shown to be positively related between different junctions and between different locations within a given junction. These data validate the use of the traffic conflict technique as a relatively rapid method of study of junction safety. At each intersection studies of vehicle speed and flow have been made and the important influence on conflicts of vehicles other than those primarily involved has again been shown.

STATENS VAEGVERK

Faeltmaetningar avseende fordons- och gaangtrafikens framkomlighet i signalreglerade korsningar (Traffic surveys concerned with the passage of pedestrians and vehicles at signalized intersections)
TV 127
Statens Vaegverk, Stockholm, 1977. 104 p.

IRRD 228522 (I)

This report describes three investigations concerning traffic flow at signalized intersections. The studies consider: (1) the conflicts between left-turning and opposed vehicle traffic, (2) the conflicts between pedestrians and turning vehicles, and (3) the effects of approach width and lane markings on the saturation flow of non-turning vehicles. In the first study the conflict is characterized by the time interval. The results show a time interval of 4.8 seconds for minor intersections. The time interval increases with the size of the intersection and was found to be less in Stockholm (population 1 million) than in Malmö (population 250.000).
The parameter measured in the second study was the difference in expected arrival time at a point of conflict between the pedestrian and the vehicle. The results show that a vehicle driver usually rejects a time advantage relative to a pedestrian unless the advantage exceeds 3 seconds. The results of the third study show that the effect of number of lanes was less than expected, due to parallel queues in wide lanes, and that the optimum lane width was between 3 and 4 meters.

STOCKON, W.R.; MOUNCE, J.M. & WALTON, N.E.

Guidelines for application of selected signs and markings on low-volume rural roads

In: Traffic control; Signals and other devices, Transportation Research Record 597, pp. 26-32
Transportation Research Board, Washington, D.C., 1976

IRRD 227078 (A)

Existing standards and guidelines for the application of signs and markings are unsuited and inefficient for use on low-volume rural roads (roads with less than an average of 400 vehicles/day). To alleviate this inadequacy, several potentially hazardous situations were evaluated to ascertain actual needs for signs and markings as they relate to economy and safety. These evaluations were based on recent research and on probability of conflict analyses with regard to the needs for signing and marking of intersections, horizontal curves, and sections of inadequate passing sight distance. The research revealed that more efficient intersection control can be attained from the careful application of stop signs and cross-road warning signs based on approach speed, sight distance, and combined intersections volumes. Treatment of horizontal curves can be made more efficient through the application of more stringent guidelines without adversely affecting safety. Striping of no-passing zones was found to be very inefficient in most instances because the probability of conflict in these situations is virtually nil; guidelines for alternative treatments are presented. Overall, the authors felt that application of guidelines suited to the rural context would result in savings in time, money, and frustration on the part of responsible agencies.

TAYLOR, J.I. & THOMPSON, H.T.

Identification of hazardous location

Final report. Report No. FHWA-RD-76-44
Department of Transportation, Federal Highway Administration, Washington, D.C., 1976. V + 142 p.

IRRD 229296 (I)

The principal objectives of the research project were to develop and verify procedures for identifying hazardous locations on all highway facilities except freeways and those systems within the central business district (CBD). A hazardousness rating formula (HRF) was developed which incorporates both accident and non-accident measures. or predictors. The intent of such a formula is to supplement, rather than replace, accident record systems in establishing the relative hazardousness at spot locations within the highway system. The formula provides a means for establishing a hazardousness index for any suspect site. The HRF incorparates data inputs regarding the number of accidents per year, accident rate (accidents per million entering vehicles), accident severity, sight distance, volume/capacity ratio, traffic conflicts, erratic maneuver counts, and two subjective indicators-driver expectancy and information system deficiencies. The form, control values for establishing three levels of hazardousness (normal, hazardous, and very hazardous), and scaling charts necessary to convert raw data values into a hazardousness indicator value are presented for each indicator. The concept of the hazardousness rating formula to assess relative hazardousness at spot locations appears to be valid, based on the results of workshops conducted as part of the research project, and limited statistical analysis of data from 12 study sites.

TAYLOR, J.I, & THOMPSON, H.T.

Determining hazardousness of spot locations

In: Evaluation of transportation operational improvements, Transportation Research Record 630, pp. 38-43
Transportation Research Board, Washington, D.C., 1977

IRRD 233594 (A)

This paper presents a procedure to assess hazardousness at spot locations on all highway facilities except freeways and in central business districts. Indications of hazardousness included in the rating procedure are number of accidents per year, accident rate in terms of annual traffic volumes, accident severity, volume/capacity ratio, sight distance, traffic conflicts, erratic maneuvers, driver expectancy, and information-system deficiencies. A raw-data format was selected for each of these indicators, and a scaling technique was developed that permits the combination of inputs from the several indicators to produce a hazardousness rating on a cale from 0 to 100. The procedure may be used even if data on all indicators are not available for a given site (level of confidence in the results diminishes). Sixteen traffic engineers and safety experts, representing 14 states, were invited to two workshops to review the procedures formulated and to assist in establishing the weights to be assigned to each of the indicators. The general concept underlying the convergence-of-evidence procedure is highly acceptable to the safety personnel who participated in the workshops. Of special note is the development of a workable form for obtaining subjective evaluations of hazardousness in various highway situations.

VAN DER LINDEN, H.R.

Conflictobservatie: De ontwikkeling van een meetinstrument (Conflict observation: The development of a measuring instrument)
Verkeersdienst Rotterdam, Rotterdam, 1975. 35 p.

IRRD 231876 (SWOV PB12753) (I)

The conflict observation method was developed in 1967 by General Motors Research Laboratory. The method is based on survey research used in the behavioural sciences. The validity and reliability of the conflict observation method is studied, and it is shown that further research is needed in particular on how the method can be improved for the recording of accidents.

VERHOEVEN, A.J.

Analyse bij bijna-ongevallen op overwegen (Analysis of near-miss accidents on level roadway crossings)
Rijksuniversiteit Utrecht, Utrecht, 1970. 25 p.

(SWOV PB4778) (S)

The study is done to get a deeper understanding to the factors which play a role in near-miss accidents. An overview of level crossings which had a high near-miss accident rate was made and some conclusions were drawn, a.o. the most interesting common characteristics of level crossings.

VERKEERSBUREAU AMSTERDAM

Vergelijking van kruispuntontwerpen met betrekking tot de te verwachten ongevalsvatbaarheid door toepassing van de conflictpotentieelmethode (Junction lay-outs related to their accident potential by using the conflict method)
Verkeersbureau Amsterdam, Amsterdam, 1974

(SWOV PB12809 fo) (S)

A comparison is made to different lay-outs of junctions at regarding their accident proneness. From the point of view of safety an interchange is, of course, more safe than an intersection. Much more research is wanted, o.a. to develop a method for a conflict-analysis on junctions.

ZAIDEL, D.; KATZ, A. & ALGARISHI, A.

A case study of pedestrian-vehicle conflict

Publication No. 77-7
Technion - Israel Institute of Technology, Haifa, 1977. 10 p.

(SWOV PB12810) (S)

The pedestrian crossing behaviour was studied on a divided four lane street. The street was divided naturally into two parts by a signalized intersection, one part having a pedestrian safety fence the entire length of the raised median, the other part (with the same street geometry) having no safety fence in the median. The following aspects were studied: pedestrian pathways across the street; pedestrian risk taking; micro traffic conditions and pedestrian-vehicle conflict.

ZEGEER, C.V.

Development of a traffic conflicts procedure for Kentucky

Research report 490
Kentucky Department of Transportation, Lexington, 1978. 26 p.

IRRD 236220 (A)

The objective of this report was to develop a procedure for the collection and use of traffic conflict data. Data were collected at five intersections to determine characteristics of conflicts. Observer reliability was found to be excellent. Traffic volumes accounted for only about 30 percent of the variation in numbers of conflicts. At one intersection, repeatability of conflict numbers, rates, and types was found to be very good. A total of 6,535 conflicts and 2,957 benign weaves were observed at the test sites based on the data, recommendations were made for collecting data during three peak hours at each site. Revised conflict data sheets were developed for signalized and nonsignalized intersections. The conflict diagram is illustrated and recommended for use. Collection of conflict data is recommended during inspection of suspected hazardous locations.

ZIMMERMAN, G.; ZIMOLONG, B. & ERKE, H.

The development of the traffic conflicts technique in the Federal Republic of Germany

In: Proceedings of the First Workshop on Traffic Conflicts, Oslo, 1977, pp. 99-110
T.Ø.I., Oslo / L.T.H., Lund, 1977

(SWOV PB12912) (S)

The traffic conflicts technique is intended for application in a large number of problems, especially as a diagnostic instrument; as an experimental evaluation of traffic facilities and as an instrument for traffic observation and control. A definition of conflicts, methods of conflict measurement, study design and measurement technique and future research are discussed.

ZIMOLONG, B. & ERKE, H.

Experimental validation of traffic conflict technique

University of Technology, Institute of Psychology, Brunswick, 1977

(SWOV PB12811) (S)

In an effort to proof the valid connection between conflicts and accidents observations of conflicts were done at 6 approaches to road intersections.
Starting out from an American recording manual the types of conflict were changed in a way that an assignment to the accident categories of the official list of the causes of accidents was possible. Further, a new breakdown of the seriousness of conflicts had to be developed. The recorded conflicts were set off against the accidents of the past 3 years. A multiple regression rate featuring the criteria of the quantity of traffic and degrees of the seriousness of conflicts lead to a satisfactory forecast of accidents.

ZIMOLONG, B.; SCHWERDTFEGER, W. & ERKE, H.

Erhebung von Verkehrskonflikten an Knotenzufahrten (Census of conflicts at junction access roads)
Zeitschrift für Verkehrssicherheit 23 (1977) 2: 51-58

IRRD 306925 (SWOV PB12812) (I)

Determination of critical traffic situations by means of the traffic conflict technique enables accident black spots on roads to be determined. The method provides for the checking of a valid relation between conflicts and accidents. An American census manual showed that there were so many different types of conflict that it is possible to assign them to the accident categories of the official accident cause index, and that a new classification of conflict severity was necessary. Conflicts were counted at six junction access roads and assessed with the accidents of the past three years. The use of multiple regression with the criteria traffic volume and degree of conflict severity leads to a satisfactory prediction of accidents.

ZUERCHER, R.

Der Beinahe-unfall am Fussgängerstreifen (The near miss at pedestrian crossings)

The Voice of the Pedestrian (1978) 9: 53-63

IRRD 236296 (SWOV PB13469) (I)

For a traffic safety campaign on communication at pedestrian crossings it is necessary to study the objective data on the behaviour of the pedestrian and the drivers in near miss situations. From these data it is shown that pedestrian crossings are conflict points, at which accidents are likely to occur. Critical situations arise at these crossings because of the fact that pedestrians and drivers do not pay attention to each other. The solution does not lie alone in the change of their attitudes but also in the improvement of the information given relating to such places.

ZUERCHER, J.D.; SASS, E.J. & WEISS, J.M.

Analysis of near-accidents and accidents on the highway

Behavioural Research in Highway Safety 2 (1971) 2: 98-106

IRRD 204882 (SWOV PB4433 T) (A)

The cause of accidents on the highway can be attributed to three main factors: (1) the highway itself, (2) vehicle(s), and (3) driver(s). Using the Critical Incident Technique, observers were asked to clearly recall an accident or near-accident and to judge the elements leading up to the incident. Two samples were polled: college students and taxicab drivers. The driver himself was blamed for the accident or near-accident much more than either the highway condition or the vehicle(s). Inattention and excessive speed were the most commonly mentioned factors, and driver skill was most frequently listed as the element responsible for either avoidance of an accident or reduction of its seriousness. The driver himself, including his attention, judgment, and skill, was seen as the important ingredient for safety on the highways.