Origin, Validation and Implementation of the Traffic Conflict Technique (TCT) in the U.S.

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Origin of the TCT

It would be presumptuous for an individual or agency to claim total credit for development of what is generally referred to today as the TCT. Any engineer, researcher, or technician who has had the responsibility of observing a known hazardous highway location for purposes of identifying problems has, in a sense, performed a traffic conflict study.

The problem, however, with simply observing a spot location in order to detect problems without the use of observation aids is that the human mind cannot always sort, categorize, measure and count what is seen with the eye. The solution, therefore, is to predefine and order observation based upon known characteristics of motorized, nonmotorized and pedestrian traffic so that the objective recording and synthesizing of data can be accomplished.

Thus, the TCT is nothing more than a set of definitions that are based upon the most common multi-vehicle interactions, particularly those that can be paired with corresponding accident types. It is usually implied in the definitions that the observed traffic interactions demonstrate high observer reliability; that is, with proper training, most individuals should be able to observe and record these interactions in nearly the same way. The definitions further imply that the observed traffic interactions are repeatable; that is, subsequent events by type will continue to occur in the same way under similar conditions.

In 1968, two researchers with the General Motor's Research Laboratories were assigned the task of observing traffic at intersections to see if differences could be detected in the way General Motor's vehicles performed relative to other manufacturer's products. While they could see nothing special about the way General Motor's vehicles performed, it was evident that all vehicles, regardless of manufacturer's nameplate, did take evasive action in much the same way.
At first, it was hypothesized that near misses, or, what we would today call "serious" conflicts, might in some way constitute an indicator of potential accidents. However, after observing traffic at many locations under high volume, high speed conditions, it was concluded that, like accidents, near misses were relatively rare events. But, there still occurred large numbers of events that were characterized by either brake light indications or swerving maneuvers.

Thus, a basic definition was posed that these traffic events were "conflicts" in the flow of traffic and that, therefore, a traffic conflict was an evasive action, characterized by brake light indications or swerving, change of path maneuvers that one vehicle took to avoid a possible impending collision with another vehicle.

It is important to note that a conflict could only be recorded if both the offending and the offended vehicles could be seen, thus eliminating normal braking for traffic control devices.

The basic definition was, then, broken down into 24 sub-definitions, each of which corresponded to an existing accident type. Using these definitions, a sampling approach to gathering data was tested and field procedures were developed as a result of trial and error experimentation.

What remained was to develop field data forms, conduct a number of specific counts utilizing all the procedures and discuss this potential new tool with local and State highway representatives. The primary argument was that the conventional use of accident data as a measure of performance is, in a sense, archaic and depends upon system failure (i.e., accident histories) to provide data with which to correct safety hazards. It was further argued that the use of the TCT might enable highway personnel to implement improvements before accidents occurred and that, in time, a more formal study might demonstrate that traffic conflicts are a surrogate for accidents.

Enough interest was generated as a result of these first studies that a paper was presented at the Transportation Research Board in 1968. This, in turn, was followed by the conduct of a 3-State demonstration project sponsored by the Federal Highway Administration (FHWA) and provided the impetus for many small underfunded research studies, many of which were subsequently determined to be flawed in design.

It became clear that there were two basic applications of the TCT:

1. As a diagnostic tool for identifying operational problems.
2. As a safety evaluation tool for predicting accident experience.
Further, it was now recognized that the various conflict types would result in significantly different accident/conflict ratios and that larger, more heavily funded studies were necessary. At this point in the mid seventies, the only application being made of the TCT was for diagnostic purposes.

Interest remained high, however, and in 1978 the Transportation Research Board, through its National Cooperative Highway Research Program (NCHRP) initiated a study to develop a standardized set of operational definitions and procedures for measuring traffic conflicts. The research included the proposal of various candidate TCT definitions and the conduct of extensive comparative field tests. Over 9 weeks of field data were collected using 17 observers trained for this specific purpose. Analysis of the data led to a recommended set of 12 definitions, all of which demonstrated very high observer reliability, and which were similar to the original GM definitions. Results of the study were published in 1980 as NCHRP Report 219, Application of Traffic Conflict Analysis at Intersections.\(^1\)

By this time, interest in the TCT as an operational tool in the U.S. began to decrease due to lack of knowledge of the conflict/accident relationship. It was obvious that if the TCT was to survive, a validation study was necessary as well as the development of a training package that included how to interpret conflict data. It should be noted that the original GM work and most studies that followed did not produce acceptable conflict/accident ratios, so the user community never quite knew how to determine when a conflict count indicated that a potential traffic problem was serious enough to warrant remedial action.

In summary, the early GM work provided much of the conceptual basis for the development of conflict techniques in other countries. Each member country of the International Committee on the Traffic Conflict Technique (ICTCT) that has been influenced by the GM work has produced their own definitions and technical refinements. Some of the TCT's used by others are a radical departure from the GM approach; however, it can generally be said of each variation that regardless of the definitions adopted or the procedures utilized to count and interpret data, the overriding purpose of the technique is the estimation, before accidents occur, of the degree of existing hazard.

**Validation of the TCT**

This discussion is offered from the perspective of an attempt to implement the TCT on a large scale among city, county and State highway personnel in the U.S.

The most significant obstacle to past attempts to implement the TCT in the U.S. was the absence of research that established a positive relationship between conflicts and accidents. There was much interest in the TCT in the
seventies, but despite the fact that its use for diagnostic purposes was successfully demonstrated, highway agencies were reluctant to commit funds for safety and operational improvements on the basis of vehicle interactions that were only theoretically related to accidents. In the U.S., accident data is and probably always will be the ultimate measure of safety performance.

As a result, the TCT is not used operationally on a widespread basis. Recent use has been confined to specific research studies where it was obvious that accident data was either not available or would not provide a sensitive enough measure.

In an effort to deal with this problem, the study Relationships Between Traffic Conflicts and Accidents was conducted and published in 1985. The purpose of this study was to establish relationships between traffic conflicts and accidents, and to identify expected and abnormal conflict rates given various circumstances. The data for this study were collected during the summer of 1982 at 46 intersections in the city of Kansas City, Missouri, and was limited to daytime and weekday traffic, and to dry pavement conditions. The extent to which the findings can be extended to other conditions is not known, but based on general safety research, accident/conflict ratios may be higher at night and when the pavement is wet or icy.

The 46 intersections studied were stratified as follows:

1. Signalized, high volume,
2. Signalized, medium volume,
3. Unsignalized, medium volume,
4. Unsignalized low volume.

Each intersection was observed for four days, thus providing four replicate data sets. The conflict definitions tested in National Cooperative Highway Research Program Report 219 were used. Accident data were obtained for each of the 46 intersections for the years 1979, 1980, and 1981. Data for 1982 was acquired for eight randomly selected intersections for use in testing the prediction methodology. All accidents were classified according to whether or not they were conflict-related and met the TCT data collection time, and pavement condition requirements.

There were 24 specific conclusions to this study, but those most likely to be referred to are:

"The proper use of conflicts is to estimate an expected rate of accidents, as opposed to predicting the actual number that might occur in a particular year. Accident data fluctuate greatly from year to year; the best one should expect is to be able to accurately and precisely estimate the average (expected) value."

and
"Overall, traffic conflicts of certain types are, indeed, good surrogates of accidents in that they produce estimates of average accident rates nearly as accurate, and just as precise, as those produced from historical accident data. Therefore, if there are insufficient accident data to produce an estimate, a TCT study should be very helpful."

It is probably safe to say that safety evaluation methodology employed in the analysis of hazardous highway locations in the U.S. is in many instances nonexistent, and, at best, not well understood. Therefore, many highway personnel who have safety evaluation responsibilities will likely only accept simple answers to the TCT validity question if there is to be widespread acceptance of the TCT.

The conclusions that the user community is looking for are not those stated above with their references to estimates of average accident rates, but one that might simply state:

Research has shown that traffic conflicts are good surrogates for accidents.

Thus, while the credibility issue has been addressed to some extent (i.e., under certain conditions certain conflict types are good surrogates), those who would implement the TCT are faced with at least two significant new problems:

1. Since prediction methodology forms the basis of the accident/conflict relationships, then prediction methodology itself, as well as TCT counting and analysis methodology must be a part of any training program. This will no doubt complicate the Traffic Conflict training task by introducing controversial, seldom used evaluation procedures.

2. Because the accident/conflict relationships must be used only within the context of the conditions under which they were derived, the task of translating research results into tables and/or other user oriented aids will require some developmental work along with the training package assembly. The following study conclusion illustrates this point:

"If a potential TCT user determines that his conflict rates and variances differ substantially from those obtained in the midwest U.S.A. during this study, he will have to adjust the values given in Tables 3 through 6. The procedure is described in Volume 2, and involves the use of a few simple equations and interpolating from an available statistical table."
Due to these and other potential problem areas, the shift from informal evaluation procedures utilizing only accident data to a more sophisticated prediction methodology that can employ both Traffic Conflict and accident data on a large scale among the user community will be difficult to achieve. Nonetheless, the commitments have been made to attempt this task. It is not likely that funding will be available for additional research activities and once the current training activities are completed, Federal funding for implementation will probably not be available. It will be at least three years before the level of interest in the U.S. can be measured and probably five or more years before the practicality of operational use by various highway agencies can be assessed.

Implementation of the TCT

The practical application of the TCT in the U.S. on a large scale will be attempted according to the following schedule:


Phase 2, October 1988 - October 1989 - Inclusion of a 3-day FHWA sponsored course for interested highway agencies as part of the annual training program.

Phase 3, beginning October 1989 - Establishment of a centralized source to promote and supply information on successful U.S. applications and other techniques, especially severity rating concepts developed through the ICTCT.

The objective of the training contract is to develop a course to train state and local highway engineers and technicians to:

1. Conduct traffic conflict studies,
2. Train others to be traffic conflict observers,
3. Analyze and interpret traffic conflict data.

The contractor will be required to develop an Observer's Manual and Engineer's Guide (two separate publications) as well as a 3-day training course outline which will use these two publications as the primary training materials. The publications will incorporate the research work described in NCHRP Report 219, Application of Traffic Conflict Analysis at Intersections and FHWA Research Report, Relationships Between Traffic Conflicts and Accidents.

The Engineer's Guide will include how to train observers, when and where to conduct conflict studies, type data to collect, data analysis and interpretation procedures, TCT applications, and a description of the procedures necessary for normalizing conflicts data to reflect the highway and/or driver characteristics of a particular geographical area.
The 3-day training course outline is to include general information, course objectives, agenda and schedule and is to be structured so that personnel with only a basic knowledge of the TCT can arrange for and present the course.

As a part of the contract, two 3-day pilot presentations for up to 25 participants each will be held. The purpose of the pilot presentations will be to evaluate the course materials and procedures so that revisions can be made prior to the offering of this course as part of FHWA's annual training program.

Following the completion of the two year contractual effort, the course will be listed in the FHWA annual training program. The offering of this course beyond one year will depend upon the interest generated through regular promotional efforts such as flyers and announcements in newsletter and technical magazines.

Obviously, the major emphasis in this approach to the practical application of the TCT is to introduce an easily understood, uncomplicated version of the TCT so that it might be employed on a large scale. If widespread interest is generated, the training effort will be followed by the establishment of a centralized U.S. source for the dissemination and exchange of information regarding practices and experience in the use of the TCT.

Through this source (probably FHWA) information resulting from ICTCT activities would be distributed and users encouraged to experiment, for example, with various severity rating procedures.

Thus, the work started in the late sixties by two individuals who had no prior experience in the highway safety area and who, by 1972, were no longer involved with the TCT, has significantly affected the way many of us think about safety evaluation methodology. Traffic Conflicts are, by far, the most promising of the potential safety performance measures to be considered as a surrogate for accidents. However, the extent to which the TCT becomes an operational tool with widespread application by highway agencies at the local and State level is yet to be determined.
