What Task is a Traffic Conflicts Technique intended for?, by S Oppe, Institute of Road Safety Research/SWOV (The Netherlands).

In general it can be said that the basic purpose of the traffic conflicts technique is to determine the safety at different points or under different conditions, when there is no information about accidents or when the information is unreliable.

One of the questions which are often raised when the conflicts technique is proposed is: can future accidents be predicted better on the basis of many conflicts or based on few accidents? Essentially this is the question about the relation between the predictive validity of the conflicts technique and the reliability of this technique and of the accident history. One of the problems regarding the reliability of the conflicts technique has to do with the precision of the operational definition of a conflict. If there is any ambiguity in the definition then it is difficult to identify an occasion as a conflict. A second problem has to do with the length of the sample period and the representativity of this period for the whole period under consideration. However a perfectly reliable technique does not need to be valid. It is in fact the problem of the validity that causes the change in attention in recent research from conflicts to serious conflicts.

The question stated above can be rephrased in terms of reliability and validity as follows.
Is the validity of a reliable conflicts technique high enough to predict accidents better than the unreliable accident data? This problem about the reliability - validity relation is well known in psychological test theory (see Lord & Novick, page 69 pp). We shall use some of the results of this theory to formulate a decision rule for the choice between two measures.
Let us define unsafety operationally as the expected number of accidents. "Expected" means her something like: conditions being the same (stochastic variables like traffic flow, whether conditions etc. equally distributed over the whole period of investigation), the mean number of accidents per

year converges to some value if the number of years tends to infinity.
Call this number, A_{∞}, the criterion of unsafety, then the value of this criterion can be estimated from the number of accidents in a certain year, like generally a population mean is estimated from a sample mean.
Moreover, let us define the reliability coefficient of a measure M as the product-moment correlation coefficient r_{mm} between two series of measurements, the series being independent measurements of the same objects at two occasions.
Now, if we have two series of accident counts, then r_{aa} tells us how reliable the safety criterion is measured. If we have two series of conflicts, then r_{cc} tells us how reliable the conflicts are measured. We know nothing from the conflicts about the criterion yet.
The correlation between a series of accident counts and conflict counts r_{ac} regarding the same situations gives us this kind of information.
This value r_{ac} however is not the correlation of C with the criterion values but with estimates of these values. If we define the correlation between C and the criterion ($r_{a\infty c}$) as the validity coefficient then this value can be estimated from r_{ac} and r_{aa} as follows:

$$r_{a\infty c} = \frac{r_{ac}}{\sqrt{r_{aa}}}$$

Then the correlation between the accident counts and the criterion is

$$r_{a\infty a} = \sqrt{r_{aa}}$$

The ultimate coefficient of validity, which is reached when

C is measured completely reliable will then be:

$$r_{a\infty c\infty} = \frac{r_{ac}}{\sqrt{r_{aa} \cdot r_{cc}}}$$

Example:

If $r_{aa} = .50$ and $r_{a\infty c\infty} = .80$, then

if $r_{cc} = .90$, $r_{a\infty c}$ will be .76

if $r_{cc} = .70$, $r_{a\infty c}$ will be .67

In the first case it is preferable to use the conflict counts, however if $r_{cc} = .70$ then the accident counts will predict the accidents better.

To get an idea of the practical implications an example will be added with an analysis of real data. The data are taken from the SWOV-Investigation into road safety in De Beemsterpolder (SWOV, 1974, table 24 and SWOV, 1976, table 8).
The data refer to accidents at intersections during the two periods 1971 - may 1973 and june 1973 - 1975.
The following data are gathered: accidents with material damage only, injury accidents, fatal accidents, traffic volume for each leg of the intersection.
In this analysis the following data of the first and second period are used.

T : total number of accidents
M : number of accidents with material damage only
I : number of accidents with casualties (fatalities + injured)
F : product of volumes on main road and cross road
V : sum of volumes on main road and cross road.

Although knowledge about conflicts would have been preferable, we use F and V because this is the only data available.
Let us predict the total number of accidents T of the second period from the data of the first period and use the correlations as an index of predictability.
From the first column of Table 1 it can be seen that T is the

best predictor, M is second, F is third, I is fourth and V is last.
At first sight it may look somewhat strange that F predicts T better than I does. An explanation for this may be found from column 2. F turns out to be very reliable, while I is not.
The correlations in column 1 are not the correlations with the criterion, but with an estimate of that criterion. To correct for this fact, we have to divide the correlations by the square root of r_{tt}. These value are given in column 3. To see if F predicts T always better than I does, we have to divide the values in column 3 by the square root of the values in column 2. Now we get the ultimate possible prediction of T by completely reliable predictors.
This results in the validity coefficients of column 4. From this column it can be seen that I has a higher ultimate validity than F although F predicts the total number of accidents better.
As a final note it may be stated that accidents do not predict accidents much better than the product of volumes in this case and that the sum of volumes is a useless measure.
It seems from these data that conflicts can do hardly better than the product of volumes. The reason for the small difference may be the homogenity of the intersections. If the intersections are completely identical in lay-out and traffic flow, then the ratio between the number of accidents and the product of volumes will tend to be equal for all intersections as is the ratio of accidents and conflicts.
In most cases the assumption is however that some locations are more dangerous than other and A, I or M will predict much better than F does.

So far we did speak only about a decision between two measures (e.g. few accidents and many conflicts). Another possibility is to combine these measures in order to get a better prediction. If we apply multiple linear regression to the data mentioned before in such a way that the total number of accidents of the

second period (T_2) is estimated from the value of T_1 of the first period and if we try to improve this solution by adding the product of traffic volumes (F) then we find as regression weights $b_T = 9.959$ and $b_F = 4.709$.
Given the variance of T in the second period = 234,5 we see that $9.959^2/234,5 \times 100\% = 42,3\%$ of the variance in T_2 is explained by T_1 (which follows also from the fact that $r_{tt}{}^2 = .65^2 = .423$).
An additional 9.5% will be explained from the values of F.
The variance of b is VAR(b) = 5.14.
Thus under the assumptions of normal distributed variables we find that b_F differs significantly from zero at 5% level.
As a result it can be stated that T_1 and F predict T_2 better than T_1 does alone.
The same line of investigation can be followed according to accidents and conflicts, conflicts and serious conflicts, conflicts of type a and b and so on,

	r_{tx}	r_{xx}	$r_{t\infty x}$	$r_{t\infty x\infty}$
T	.650	.650	.806	1.00
M	.594	.678	.736	.894
I	.495	.684	.614	.742
F	.588	.978	.730	.738
V	.301	.991	.373	.374

Table 1.

Validities with regard to an estimate of the unsafety criterion, reliabilities, validities with regard to the criterion and ultimate validity with regard to the criterion for total number of accidents (T), accidents with material damage only (M), accidents with casualties (fatalities + injured) (I), product of traffic volumes (F) and sum of traffic volumes (V).
x stands for T, M, I, F and V respectivily. These values are measures from the data of 24 intersections over two periods.

REFERENCE

F.M. Lord & M.R. Novick: Statistical theories of mental test scores, London 1968.