based on normalizing data; and through trends or changes in trends. Each method provides a different result.

For example, according to absolute numbers, male drivers between the ages of 16 and 35 are highly overrepresented in weekend nighttime accidents. But if the data are normalized, then teenage drivers are overrepresented on a per-vehicle-mile basis and older drivers are overrepresented because they drive more frequently at night. Normalized data also suggest different countermeasures. For the teenage driver, the problem is one of skill or attitude, and training may be a useful countermeasure. For the male driver between 20 and 35, the problem is one of nighttime exposure, and the countermeasure would involve reducing that exposure. For the elderly driver, the problem is a combination of low exposure with increased risk per mile or unit of exposure.

Different data treatments can determine the success or failure of a safety program. For example, NHTSA has pointed to the declining fatality rate per 100 million vehicle miles as evidence of the success of national highway and motor vehicle safety programs; in its critique of the grant program, the U.S. General Accounting Office emphasized the increase in absolute numbers of fatalities since 1965 and therefore questioned the value of the program.

Policy considerations may also differ, depending on whether the focus is on total exposure or on risk per unit of exposure. For example, a recent study claimed that driver education was causing teenage fatalities. While teenagers in fact have a higher rate of accidents per mile driven, most of the increase in fatalities cited in the study was due not to a change in risk per mile, but rather to increased exposure resulting from the availability of high school driver education.

How then shall we use accident records for problem analysis and planning? The accident record systems lend themselves to analysis of total numbers of accidents, and our methods of correcting the exposure are relatively weak. If we use total numbers of accidents as our measure of success, we may find ourselves defining alternative transportation systems (mass transit) as highway safety programs. This may be appropriate; then again, we may not want to spend our limited safety funds on mass transit.

In all probability, there is no single measure applicable to all situations. But it will be our task to find appropriate ways of using accident statistics to define problems and to manage highway safety programs.

INTRODUCTION AND CONFERENCE PURPOSE

Wayne S. Ferguson, Virginia Highway and Transportation Research Council

When the need for this conference was established by the Transportation Research Board's Committee about a year and one-half ago, we did not envision the environment in which highway safety practitioners would find themselves today. Certainly the need to curb inflation and to promote real economic growth is of such national significance that, if deep cuts in federal spending are now necessary in many areas of federal activity, we would not argue that this program alone ought to be exempted. We would maintain, I believe, that unsuccessful programs ought to be cut and successful ones sustained. Have we been successful? Apparently, many people think not. We need to assess both where we are and how we got here.

To be sure, things are not as bad as they might be. But the funding levels proposed for FY 1982 and beyond reflect a substantial retreat from the commitments of resources to highway safety that began in 1966-1967. And we need to ask, Have we in the state and community programs done our jobs so well that further effort is not needed? Or have we done so poorly that further financial commitment seems, in investment terms, a poor risk? I am afraid that the answer is, We don't know.

I believe that the U.S. General Accounting Office noted in its October 1980 report to Congress that the state and community highway safety programs are a poor investment alternative in these days of lowered expectations of government.

If we were business people meeting here today to discuss the condition of our companies or our industries and the prospects were for 65-70 percent reductions in operating revenues, it is almost a certainty that we would know precisely how and why we had come to this position. We would be working on recovering our lost markets and lost customers.

But those of us promoting and selling improved highway transportation safety through the state and community grants program do not know what has been successful and what has not. I think part of the problem derives from the fact that we have not recognized that the bits and pieces of highway safety information we collect and maintain must be organized into a management information system to effectively plan, analyze, and oversee the highway transportation system. We have not defined our problems clearly enough and identified those factors amenable to countermeasures through the grant system.

Industry spends millions analyzing its products and its markets and carefully tailoring its short- and long-range plans to the changing environment. In comparison, we spend a pittance on identifying and analyzing those characteristics of the highway traffic crash problem so that we can sharply focus on the goals and objectives of our spending programs.

If we are ever to sharpen the focus of our programs, we must find a way to make our management information systems more useful. We hope this conference will provide a start.

TRAFFIC RECORDS ANALYSIS IN TEXAS

Barry Lovelace and John Staha, Texas State Department of Highways and Public Transportation

In Texas we use the traffic record as a source of data for three levels of problem identification and analysis: macro, midrange, and micro. This three-layer concept has been adopted as a means for "layering" into problem identification for decision making. The purpose of the macro level is for statewide comparisons and problem assessment. It consists of problem identification by using the Fatal Accident Reporting System (FARS) at a gross level and will not be discussed here. The midrange level is the basis for resource allocation; the micro level is used for treatment. Texas uses different techniques for each:

- SAVE CITY/SAVE COUNTY is a decision model used for midrange analyses. Cities and counties are rank-ordered by accident count and rate to form a basis for resource allocation.
- CASESTUDY and Traffic Accident Profile (TAP) are two computer programs used for microlevel analyses. The purpose of CASESTUDY is to retrieve information on individual accidents to identify problems in specific areas. TAP melds

engineering, enforcement, and education in an effort to get programs to work together.

Summaries of each of these techniques follow.

SAVE CITY/SAVE COUNTY INDEX

It has been axiomatic in the field of safety that an accident-free environment is not only desirable but possible. Taken to its extreme, the concept has come to mean that accident reduction is equally important in all environments, the scale of the problem and cost/benefit notwithstanding. Applied to the allocation of traffic safety resources, this has meant that any community or eligible agency has an equal claim on available resources, and appropriate mechanisms have been developed to ensure distribution on that basis. The Texas FY 1982 Highway Safety Plan is a major departure from the traditional values of the traffic safety field.

Texas receives one of the largest state allocations of NHTSA resources, but even this level of funding is inadequate, primarily because of the geographic scope of Texas and the unique problems it presents. Beginning from a premise that each district office of the Texas State Department of Highways and Public Transportation has some traffic safety problems severe enough to merit funding, the Save City/Save County program was developed with the assistance of the Texas Transportation Institute (TTI).

Save City/Save County is a decision model based on the assumption that a certain number of traffic accidents will occur regardless of the level of effort or the relative effectiveness of countermeasures. Communities above the median occurrence level obviously have more severe problems than those falling below the median. Such a measure of need is absolute; it fails to show relative severity for purposes of comparison. To alleviate this problem, a set of formulas was developed that assigns weights to two common factors (accident rate and number of accidents) to construct an index of potential accident savings for each city or county. It should be emphasized that these accident savings figures are not finite; they have no intrinsic meaning and do not represent accurate projections of anticipated reduction in the occurrence of accidents. They are, however, relative rankings of severity. These rankings are used as a basis for the selection of candidate sites.

CASESTUDY

Traffic safety analysts frequently find that they need detailed information on narrowly defined subsets of a state's accident data base. A traffic engineer in Texas, for example, may be interested in analyzing accidents along a 5-mile stretch of Interstate highway. An engineer for a motor vehicle manufacturer may be interested in learning more about single vehicle roll-over accidents for a given make or model of car. A driver education teacher may desire information on nighttime accidents involving novice drivers.

If the subset of accidents at issue is small, it is often possible to retrieve all of the individual accident reports contained within that subset for a period of one or more years. If the subset contains no more than a few hundred accident reports, it is feasible to go to the state agency in charge of maintaining these reports and request a photocopy of each. Individual accident reports are typically identified and retrieved by accident case number rather than by location, vehicle make and model, or time of day.

To analyze small subsets of the Texas accident data base without having to retrieve individual accident reports, TTI has developed a computer program known as CASESTUDY. In using CASESTUDY, an analyst defines a subset of accidents, such as fatal motor accidents, those that occur on Interstate highways between certain hours, or accidents involving pedestrian or bicycle casualties. This subset may be further defined by a variable or combination of variables related to accident, driver, vehicle, or casualty.

Once the subset of accidents is defined, the CASESTUDY program is run. Program output includes a single sheet of paper for each accident under consideration. These individual sheets of paper are referred to as case studies or proxy reports, i.e., proxies for the investigating officer's accident report. Half of each proxy report provides information on a particular accident. Included are variables such as time of day, day of week, month of year, county, road, type, severity level, weather conditions, road surface conditions, location, and number of people injured in the accident. The other half contains details on the first three drivers and vehicles involved in the accident. Information includes vehicle make, style, year, type; vehicle defect; contributing factors to the accident; and driver's age, sex, and race.

Each proxy report contains an accident case number. If the analyst desires additional information on a particular accident—information that appears on the investigating officer's accident report but not on the proxy report—that accident can be accessed by case number through the Texas Department of Public Safety (DPS). Identification of the case number is particularly important given the size of the accident file: during calendar year 1980, DPS encoded reports on approximately 480 000 accidents.

The CASESTUDY program is then used to summarize the information contained in the proxy reports. This summarization consists of univariate printouts of all the variables in the proxy report. A subset of 100 accidents would produce 100 pages of proxy reports and several summary pages of univariate tables displaying accident, vehicle, and driver information relevant to those 100 accidents.

One major problem in Texas is the amount and type of data that are being collected. As previously noted, the file is very large and difficult to mesh. Also, seemingly irrelevant information such as color of the driver's clothing is being recorded while important information regarding the vehicle is not.

Regardless of these problems, however, the summary information provided by CASESTUDY, along with the individual proxy reports, is of assistance to local traffic engineering and enforcement personnel in suggesting when, where, why, and how accidents occur. And the information contained in the CASESTUDY report—supplemented by law enforcement experience and engineering judgment—will help in selecting countermeasures to reduce the frequency and severity of accidents.

TRAFFIC ACCIDENT PROFILE

The Traffic Accident Profile provides information on a city's traffic accident problems and suggests possible countermeasures. Its primary uses are to identify the types of engineering work that are necessary and to define the operational development of police plans. TAP is most effective for medium to large cities (e.g., accidents by time of day and day of week by weather conditions). In smaller cities the cells used for analysis are so small that all significance is lost. Target areas are defined by an iterative process after an arbitrary decision has been made regarding the number of areas to be evaluated in each city.

Target area analysis involves the following four steps:

1. Identifying target areas on the basis of accident totals (this involves selecting the 10 streets in a local jurisdiction with the highest number of accidents);
2. Generating tables for each of the 10 target areas on factors that might affect accidents in the target area;
3. Making commands on traffic safety problems suggested by the tables; and
4. Recommending potential countermeasures in the areas of enforcement, engineering, or education.

Analysis of target area tables is a subjective procedure supported by a general knowledge of traffic safety programs. The main factors used to identify apparent traffic safety problems are the percentage and the frequency of accidents in each cell.

The traffic accident file constitutes an exceptionally rich source of information. It should not be overlooked as a resource for multiple purposes: policy analysis, resource allocation, problem identification, and countermeasure design.

STATE-OF-THE-ART TECHNIQUES FOR COST-EFFECTIVE SOLUTIONS

Martin R. Parker, Jr., Progressive Consultants Corporation

The U.S. General Accounting Office has suggested that the Highway Safety Program has achieved only limited success in reducing the number and severity of accidents. The problems impeding the development of effective safety programs have been identified for many years. Some of the major problems are as follows:

- The direct measures of safety—accident reports—are incomplete, inaccurately reported and coded, and biased. They also fluctuate widely from year to year at a location. Thus, it is difficult to use accident records to accurately identify safety goals and problems.
- Few administrative and effectiveness evaluations of safety projects have been conducted by using sound analytical techniques. In most cases, the impacts of projects on safety have not been determined.
- Accident records systems are generally not designed for safety analysis.
- There is considerable duplication of accident records and safety-related data, and much of the available data is not used for safety purposes.
- Research results obtained from studies conducted by federal and state agencies, universities, and other agencies are not used effectively to improve safety programs.
- Many safety administrators believe that every dollar spent on safety is worthwhile.
- Many agencies do not have personnel adequately trained to conduct safety analyses.
- Effectiveness and economic analyses are often conducted to justify the selection of safety projects rather than to determine whether projects are justifiable.

Every state has made progress implementing safety programs during the past 80 years; achieving further significant reductions in accidents and their severity during the next several decades may be impossible. A more realistic goal may be to maintain the current accident rate or number of accidents per 100 000 population (or registered vehicles). This pessimistic view is, in part, supported by the following observations:

1. The current impediments to achieving safety results cannot be overcome immediately. Even with pre-1981 safety funding levels, it would take 10 years or more to upgrade safety programs to the point where significant measurable results could be shown.
2. There are no major developments envisioned within the foreseeable future that will lead to improvements in highway safety. For example, no major highway construction program, such as the interstate system, is contemplated.
3. Safety budgets at the state and local level are likely to be reduced as funds are spent on more pressing issues such as maintaining essential services.

Given existing and future constraints, it is imperative that safety administrators improve the efficiency of their operations and the effectiveness of their safety projects and programs. Fortunately, the analytical techniques and technical equipment for achieving success are available. The challenge faced by safety administrators is to apply state-of-the-art methods to increase the probability of implementing cost-effective solutions. In many cases, the techniques are not labor intensive, nor do they require large capital investments for implementation.

While the level of effort is often a function of the size and safety responsibilities of an agency, a number of techniques are applicable for all agencies. Some of the most pertinent measures are described below.

PLANNING TECHNIQUES

Program administrators must establish an efficient procedure for using accident data to meet safety goals. In the planning phase, the administrator must have a data base capable of identifying specific safety problems and evaluating project impacts. The results of completed research and data bases such as National Accident Sampling System may fill the need.

While developing an integrated data base may be an ultimate goal of a safety agency, safety analyses should not be deferred until the base is completed. Local agencies can and should identify many important safety problems with existing data sources.

ANALYTICAL TECHNIQUES

Too often, little effort has been placed on using analytical techniques for safety analysis. For example, many safety effectiveness evaluations are currently being conducted simply as a comparison of the before-and-after accident frequencies. A number of user-oriented automated packages are available for more sophisticated analysis, but not all techniques require installation of complete packages. Simple manual procedures for conducting project and program evaluations have been developed by the Federal Highway Administration. The National Highway Institute will provide the manual and training course at no cost to the states.

PERSONNEL ISSUES

Safety analyses cannot be accomplished without properly trained personnel. Although desirable, it is not absolutely necessary that professional engineers make up the majority of the staff. It is essential, however, that the performance of the staff be measured. A measure of staff performance is provided by the answers to the following questions:

1. Do staff members have access to and use professional journals such as those published by the Transportation Research Board and Institute of Traffic Engineers to upgrade or improve their safety analysis?
2. Is the staff actively involved with other safety-related agencies and with the public?
3. When did the staff last attend a safety training course or seminar?
4. When did the staff last use a new or more efficient method to conduct safety analysis?

If the answers to the first two questions are no, immediate corrective administrative action is necessary. If the answers to questions 3 and 4 are "last week", the safety program is likely to be operating efficiently.