vehicle was hit, is not generally critical to evaluation; when it is, it can be obtained from other sources.

We can also limit the kinds of information officers are required to report. We need to eliminate information that officers cannot collect accurately because they have neither the training nor the time. Cutting out information that cannot be reliably gathered will reduce the amount of information to be collected without sacrificing the usefulness of the reports.

If paperwork is reduced, police will be more willing to prepare reports. Therefore, the number of reported accidents will increase.

MAKING BETTER USE OF DRIVER REPORTS

In most states, drivers involved in accidents that meet minimum damage thresholds are required to furnish reports of accidents to their insurance agencies. These reports duplicate the content if not the format of the police reports. Prepared under less trying circumstances than the police report, they could be used to provide information now currently furnished by the police. Such information would include weather conditions, speed, and the use of restraints. Drivers' reports could also be used to collect information not currently collected, such as amount of driving experience, destination, and annual mileage. Certainly, any expansion of the content of the accident reports should be directed toward drivers' reports rather than police reports.

In addition, supplementary drivers' reports could be used to collect a greater depth of information for selected classes of accidents. Drivers would be selected on the basis of information provided in the routine reports. Selection of forms and addressing of letters would be completely automated.

CONSOLIDATING FILES

Traffic records are currently maintained in a number of files by a number of different agencies. The most common files are

1. An accident file consisting of police reports, generally maintained by the state police;
2. A driver file containing information about drivers and traffic violations, maintained by the agency that issues licenses;
3. A vehicle file containing information about the vehicle, maintained by the agency that registers motor vehicles; and
4. A road file containing information about road segments and locations, maintained by state and local highway departments.

It would be helpful if accident data collected from police reports were made a part of the driver, vehicle, and road files. If the accident information were sufficiently limited, it could be recorded in its entirety. This consolidation would have the following advantages:

- Increased Amount of Information—Since the data in each file would be available, more information could be obtained about the people, vehicles, and roads involved in each accident than could be obtained from accident reports.
- Limited Data Collection—The accident report would only provide positive identification of the people, vehicles, and locations. All other information, such as driver age, vehicle engine size, and roadway surface, would be drawn from the appropriate files.
- Control of Exposure—Every time accidents were analyzed, we would know exactly the population on which the accidents were based. Analysis could be made on a per-driver, per-vehicle, and per-road-location, or per-road-mile basis. This would provide control over changes in the numbers of people, vehicles, and road location or miles occurring between groups being compared in the evaluation.

Most road files already contain a volume of accident information, but the agencies responsible for driver and vehicle files may not welcome the addition of accident information. The highway safety agency could periodically duplicate these files for their own use and add the accident information. With their own files, evaluators could analyze information without having to work around operational uses of the file.

COLLECTING EXPOSURE DATA

Research studies are designed to control differences in exposure among groups being compared. In evaluation studies, the differences in exposure must be adjusted. In the past, changes in exposure were fairly gradual and predictable from trends of previous years. More recently, however, wide fluctuations in the availability and cost of fuel have produced substantial and unsystematic variations in exposure. Until now, exposure data have been collected almost as an afterthought, but now it must be accorded the same priority as the collection of accident data.

Highway departments have done well in determining exposure of various road segments. This is so largely because the same information (traffic counts) is used for operational purposes.

Some states have begun to collect odometer readings as a renewal registration requirement to provide estimates of annual vehicle mileage. For drivers, estimates of miles traveled could be obtained as part of the license renewal process. This source would furnish a third to a quarter sample of the driver population each year. Estimates of total exposure would be generated from this sample.

None of these suggestions will solve problems that limit the usefulness of accident data for evaluation. We are not seeking solutions but ways of ameliorating these problems so that our truly cost-effective programs will be recognized.

MINIMUM RESOURCES REQUIRED FOR PROBLEM IDENTIFICATION, GOAL SETTING, AND PROGRAM EVALUATION

Jerry G. Pigman, Kentucky Transportation Research Program, University of Kentucky

The minimum resources needed to use accident statistics and other data effectively for highway safety program administration are directly related to the problem identification, goal setting, and evaluation tasks outlined in the Highway Safety Program. This program is expected to undergo a number of changes in FY 1982 as activities are streamlined to keep budgets within new funding limits.

The new NHTSA guidelines call for significant reduction in all activities. Specifically, the problem identification or analysis portion of the state's highway safety plan will be required to be only a three- to five-page summary broadly describing the state's highway safety problem, statewide evaluation plans will no longer be required, and the past requirement for one in-depth evaluation each year has been waived. However, administrative evaluation of each project will still be required to determine whether projects meet their objectives. In addition, all impact projects will be subjected to some form of impact evaluation, and the data on a minimum number of specified impact measures must be provided to NHTSA.

It is important to note that a problem identification summary will require a thorough analysis of specific program areas before summary data can be presented. Similarly, even though evaluation requirements will be reduced and some responsibility will be shifted to NHTSA, a significant amount of data for project impact evaluation will have to be collected by the states.

PROBLEM IDENTIFICATION

While many projects have immediate objectives such as increased safety-belt use, reduction in drinking and driving, or compliance with the speed limit, their ultimate goals should be to reduce the frequency and severity of accidents. The development of effective safety programs requires accurate identification of accident causes.

The problem identification process is used to determine the magnitude of various highway safety problems based on accident statistics. It involves the following steps:

1. Identification of data sources and collection of data,
2. Collection of normalizing data,
3. Analysis of data,
4. Development of the problem identification report, and
5. Ranking of identified problems.

Identification of data sources and collection of the data can be overwhelming tasks. States need adequate technical staff and an accessible computerized accident data base. The major data collection effort will be centered on the accident, driver, vehicle, and roadway files. As an example of the effort required to identify problem areas, Kentucky's problem identification report for FY 1982 includes 24 areas that were investigated. This comprehensive problem identification process may be more than the streamlined safety program can justify in the future; however, a data base has been established that will be of significant value for future programs. It is interesting to note that the areas targeted by NHTSA for FY 1982 funding are the following: alcohol countermeasures, police traffic services, emergency medical services, and traffic records. In addition, other areas that were mentioned as candidates for funding were occupant restraint and motorcycle safety. In comparison, those areas recommended for safety project implementation in Kentucky's FY 1982 problem identification report were speed-related accidents, alcohol-related accidents, safety-belt use, school-bus accidents, and vehicle defects.

The analysis to normalize accident statistics requires data on population, licensed drivers, registered vehicles, miles of roadway, miles driven, and average daily traffic. The most commonly used and readily accessible measures of exposure are population and registered vehicles, but mileage driven is particularly important in preventing misinterpretation of data. When mileage data are not available, it becomes necessary to use only population data and to evaluate the results accordingly. Because offices of highway safety most often do not have the capability to collect data on miles driven, highway safety programs must depend on data provided by other state agencies.

The analysis plan must specifically identify individuals responsible for analysis and the overall approach. Generally, the problem areas investigated will dictate the level of analysis required. The availability of normalizing data must be determined before the overall analysis plan is implemented.

In the first cut or overview, accident rates should be calculated for various jurisdictional or geographic subdivisions on a statewide basis. At this stage it may be helpful to further segregate the data by population groups. Average and critical rates can then be calculated by population category, and normalizing data can be used to establish the differences in accident frequencies.

In the next level of data analysis, subgroups of drivers, pedestrians, or vehicles, and specific problem areas such as alcohol or speeding, are identified. Additional analysis of subgroups is necessary to identify problem populations by jurisdiction, age, and sex, or problem highway locations.

Computer packages or automated data management systems such as DART, RAPID, and ADAAS appear to be necessary for performing the required levels of analysis. Data from national files to compare with state data are a useful supplement.

The problem identification report can be prepared in many forms but should include a summary of findings, conclusions, and suggested countermeasures. The findings should present the problem areas investigated, explain briefly why the problems exist, and estimate their magnitude. The conclusions should be a more refined summary of findings and a precise delineation of the problems. Countermeasures should be suggested for problems that appear to have reasonable solutions.

The priority ranking of problems used to plan countermeasure programs should be based on the degree of overrepresentation and the expectation of reasonable countermeasures to eliminate or reduce the problems. The target population and cost/benefit of the countermeasures should also be considered.

Limiting factors in the analysis are the quality and availability of data, the availability of data processing hardware and software, the number and capability of personnel, and time and budget. At this time of funding cutbacks, it has become even more necessary to establish the minimum resources required to use accident statistics and safety-related data. The core of an analysis team should be a technically oriented person who is thoroughly familiar with accident, driver, vehicle, and roadway data files. This person should also have basic statistical capabilities. Generally, the only additional support personnel required are computer programmers, technicians for data summary, and graphic artists for preparing the report.

In Kentucky, the reports for FY 1980 and FY 1981 were prepared by the Kentucky Department of Transportation by using two engineers and a support staff. The FY 1982 problem-identification report, which was generally an update of previous reports, was prepared by the same staff after being transferred to the University of Kentucky. With background data accumulated to prepare these reports and the narrowing of the problem areas eligible for funding in FY 1982, it appears that an adequate report could be completed for a reasonable cost in the future.

GOAL SETTING

Goal setting necessarily depends on problem identification; realistically, only solutions of identified problems can be singled out as practical goals. Thus, while goal setting is basically an administrative process, the decision makers must draw on support data from problem identification.

The first step in the goal-setting process is to establish initial goals and objectives for each problem area identified. The NHTSA guidelines for highway safety management present six factors that should be used in determining safety program goals. These are as follows:

1. Cumulative effort of program module impact goals on overall highway safety program impact goals,
2. Relation to support goals,
3. Link to identified problems,
4. Relation to proposed programs and projects,
5. Relation to program and project evaluation, and
6. Available sources.

Each program module is based on specific goals set in this step. When the detailed project development has been completed, the goals and objectives in each problem area should be adjusted to reflect the specific projects and activities planned. At this stage, the reasonableness and cost-effectiveness of the countermeasures should again be considered.

The second step to the goal-setting process is to combine the goals for the individual problem area into overall goals for the highway safety program. Overall goals are not a simple summary of individual goals; some may overlap. Generally, setting the initial goals and objectives should be the responsibility of the state highway agency with endorsement from NHTSA regional offices.

EVALUATION

The purpose of project evaluation is to measure the effects of a program or project against the objectives that it was designed to achieve. Specifically, the evaluation is conducted for the following reasons:

1. To determine the effectiveness of new projects as compared to existing projects,
2. To see where old projects could be improved or expanded to increase their effectiveness in achieving their objectives,
3. To measure the cause-and-effect impact of projects,
4. To discover in quantitative terms what projects have accomplished and at what cost,
5. To help select alternatives to achieve a project's objectives, and
6. To satisfy state and federal requirements for project funding.

Evaluation may be viewed as a prerequisite to planning and, therefore, as an essential part of the management process. Because evaluation requires both a statement of project objectives and a systematic collection of data on the achievement of objectives, it enables program coordinators and project managers to maintain project direction and to gauge short- and long-term consequences. Therefore, evaluation serves as the basis for change in project effort or emphasis. It allows managers to increase project effectiveness by learning from past experiences.

Like all administrative functions, evaluation requires time, money, facilities, and personnel. Since there is a very close relation between evaluation results and management decisions, it is essential that the managers have adequate staff support to perform the analysis and to provide the advice needed for a proper evaluation. The agency size and evaluation requirements will dictate the organization and size of the staff. A state can create a separate evaluation unit responsible for designing evaluation components for each program unit or assign the basic responsibility for evaluation to a staff member responsible for program element development. The first approach would involve assembling a highly specialized staff, including systems analysts and operations researchers. Such a system is frequently too expensive for state safety agencies and has the disadvantage of creating an unmanageable evaluation bureaucracy that could become self-serving and unresponsive to management needs. Under the second approach, the program manager would require support from specialists in evaluation and mathematical systems analysts hired on a consulting basis.

Generally, two basic skills are required for program evaluation: experimental design, which presumes a knowledge of statistical principles, quantitative methods, and data processing. Evaluation of most highway traffic safety programs involves the collection and analysis of data. Direct presentation of the data is often very meaningful; however, more complicated approaches that use computer-assisted data processing allow more precise and complete evaluation. The appropriate level of sophistication is usually difficult to determine, and a frequent mistake is an evaluation effort that is inconsistent with the nature of the project. This is frequently a problem when dealing with outside professional evaluators or in-house staff evaluators.

A state safety agency attempting to develop and maintain an evaluation capability should include on its staff one individual with specific academic training in experimental design, data analysis, and data presentation. Other specialists should have advanced training in statistics and computer use and should be able to apply their skills in experimental design and research in social program areas. In the early stages of developing a state evaluation program, personnel with backgrounds in both evaluation and research methodologies will be needed. As they may not be needed fulltime, they can be hired as consultants. They will be called on to assist in determining personnel requirements, to provide input in the initial development of evaluation work plans, and to review the evaluation methodology developed by the program staff. Although consultants to provide this type of assistance can be found in government agencies, these services are more typically performed by universities or the private sector.

The cost of the evaluation must be considered an integral part of program and project costs. Project plans should provide for adequate funding of its evaluation component. Projects generally fall into one of three broad categories: (a) monitoring operations that require minimal evaluation, (b) projects that provide a definite evaluation plan requiring some data collection, and (c) projects that require a relatively detailed evaluation because of the countermeasures they employ (projects in this category may allocate substantial funds for evaluation and may employ outside evaluators).

The evaluation costs in these three categories vary greatly, depending on the nature of the project. Costs for projects in the first category should be minimal. Costs for those in the third category may be substantial. To provide the minimum resources to evaluate highway safety programs, evaluation costs need not exceed 10 percent of the total project cost. Exceptions to this guideline may involve sophisticated programs requiring unusual efforts in data collection and analysis.

Reduced funding available for the Highway Safety Program in FY 1982 will obviously result in reduced staffing at both the state and federal levels. However, evaluation activities cannot be reduced proportionately because the emphasis on demonstrating impacts will increase when future funding for the program is being considered. The need for evaluation will have to be met with the reduced resources. Although NHTSA's new evaluation policy will simplify current procedures and shift some of the analytical effort from the state to the federal level, the states will continue to need technical staff to plan and manage project evaluations.

The new NHTSA guidelines provide for three types of evaluations: administrative, effectiveness, and state program. Administrative evaluation includes a comparison of planned versus actual performance or activity and the determination of unit cost in achieving the level of activity. This type of evaluation has always been required on all projects and can usually be achieved through the National Project Reporting System (NPRS). NHTSA data requirements will be limited to an initial summary of data from the project agreement and a final collection of minimum data on the performance measures specified in the project agreement. States will have very little involvement in this type of evaluation because data collection will be the responsibility of the NHTSA regional offices.

Effectiveness or impact evaluation includes the determination of the effectiveness of a project in changing behavior or in reducing death and injury on the highway. Data on impact measures have always been required of all impact projects. For this type of evaluation, NHTSA will provide data analysis services when requested by a state.

At present, NHTSA requires two types of project impact evaluations. States have been required to collect accident data on conditions before, during, and after the project as part of the evaluation phase of all projects. In addition, each state has been required to conduct at least one detailed impact evaluation each year. The requirement for the detailed evaluation has been dropped in the new guidelines, and the states are being encouraged to conduct minimal effectiveness evaluations on all their impact projects. Where the state requires analytical assistance to conduct an impact evaluation, NHTSA will perform analyses after accident data have been collected.

State program evaluation includes a general review and a program summary emphasizing accomplishments, particularly those of innovative and impact projects. Annual and semiannual reports have always been required; however, requirements for semiannual reports will be eliminated, and annual reports will be simplified. Annual reports are expected to be 10 to 20 pages long and they will be issued by the states each year on January 1.

DATA ANALYSIS AND INTERPRETATION PROBLEMS

James Nugent, Indiana Division of Traffic Safety

There are two sides to the problem identification process: the managerial side, which pertains to the way problem identification interacts with the overall state management process, and the technical side, which pertains to the statistical procedures and constraints in data analysis. It is the technical side of problem identification that concerns us here.

In practice, the technical aspect of problem identification involves the empirical techniques used to reveal correlations among accident variables. Correlations, however, do not necessarily relate to causality. A theory or hypothesis must be constructed and tested to explain the correlations, the extent of their association, and how they interact to produce accident conditions.

There are, then, two steps in technical problem identification. First, from the current research available, a hypothesis is made of the problems that exist, the circumstances under which they develop, and how they can be measured. Second, the data gathered from statewide accident records are used to test the hypothesis and to determine the magnitude of the problems in each locality.

At the state level, a number of problems limit the usefulness of accident records as the primary data source:

- Accident data are often gathered from a single data-gathering instrument that must serve many needs and agencies.
- Accident reports are often unreliable or invalid.
- Adequate exposure data are often lacking.
- The real significance of overrepresentation is often difficult to establish.

TECHNICAL CONSTRAINTS TO PROBLEM IDENTIFICATION

Accident Reports As the Sole Data-Gathering Instrument

Highway safety agencies often must rely on data from accident report forms that must serve the needs of several agencies. Even when they have input into the development of procedures, the safety agencies still cannot get all the information they require. Recently, Indiana redesigned its central accident records system. As a part of that process, a committee of representatives from several agencies met to develop a new accident report form that would serve their diverse needs. To prevent the form from becoming unmanageable, each agency was required to justify each data element and report that would be required. The Division of Traffic Safety, the only agency interested in research requiring a broad-based information system, found such justification difficult. Consequently, the report form that emerged was a compromise. Although far better than the previous form, it fell short of being an adequate instrument for research.

Data Validity and Reliability

Data gathered from accident reports is often incomplete and unreliable. Indiana, which is not an especially large state, has 225 000 accidents annually; these accidents result in more than 440 000 records on vehicles, drivers, and injured occupants. Roughly two-thirds of the reports on these accidents are generated by an investigative agency, and the remainder is reported by the public. There is little quality control, and it cannot be assumed that the inherent bias of such reports is randomly distributed.

Even with training, police often give inaccurate and incomplete reports. Indiana requires every new state and local police officer to be formally trained in accident investigation. A report by the Institute for Research in Public Safety, however, demonstrated that police frequently misidentify descriptive data, omit relevant information, and exhibit a low sensitivity to accident causation factors. According to one study, even such a simple factor as driver age was incorrectly identified in 11.6 percent of the accidents reviewed. In descriptions of the accident environment, police performance did not exceed the chance level of any factors cited. If these are the results of disinterested and professional police officers, it is reasonable to question the reliability of reports from accident participants.

Accident data may be highy unreliable for some particular subpopulations. In some states, data on motorcycle and moped accidents are combined. Because the characteristics of the two operators have been shown to be quite different, this mingling of statistics hinders proper assessment of the problem and selection of countermeasures. Similar problems are involved in obtaining separate data on trucks (and pickups), school buses, and off-road vehicles. Any attempt to refine these kinds of data is constrained by a large error factor.

Exposure Data

Exposure data used to normalize accident data are based on time, travel, events, vehicle attributes, vehicle type, and driver attributes. No one measure can serve all analytical needs; appropriate data are determined by the hypothesis being tested. For example, motorcycle exposure data are virtually nonexistent. Without exposure data, however, prioritization and comparison become problematic.

Exposure data are difficult and sometimes impossible to obtain. In Indiana, for example, annual vehicle miles traveled are obtained from gasoline tax revenues, but such broad data are obviously of low statistical value. The Department of Highways conducts special studies throughout the year, but these do not provide exposure data by age, sex, vehicle type, vehicle defect, or political subdivision.

The lack of exposure data poses severe problems in the identification of target groups. Young drivers, for example, are thought to be overrepresented in accident samples because the proportion of young drivers involved in accidents is greater than the proportion of young licensed drivers. However, the data are not controlled for vehicle miles traveled by young drivers, miles driven by sex, or the time or area in which the miles are driven. It may be