HIGHWAY SAFETY PROJECT EVALUATION SYSTEM

FINAL REPORT

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- Prepared by -

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PREFACE

The project reported here resulted from the Office of Highway Safety Planning Request for Proposal entitled "Highway Safety Projects Evaluation System", dated February 27, 1970. The Planning and Administration contract between OHSP and The University of Michigan that followed the Highway Safety Research Institute proposal (ORA-70-1251-B1) was initially scheduled for the period April 1 - June 30, 1970. During that period a 90-day, no-cost time extension was negotiated, extending the contract close date to September 30, 1970. The report that follows summarizes project activities for that six - month period.

ACKNOWLEDGEMENT

Overall responsibility for this project and the report that follows rests with the authors. Major support for the individual action project review phase, summarized in Section 2.0, was provided by various HSRI personnel, including W. L. Carlson, D. E.Cleveland, J. S. Creswell, Jr., L. D. Filkins, T. L. McDole, D. J. Minahan, Jr., J. O'Day, J. H. Saalberg, and R. E. Scott; consultative support was provided by J. W. Little, University of Florida, and D. Klein, Michigan State University.

Finally, what measure of success was achieved by the project must be largely attributed to the unreserved support and enthusiasm of N. Bufe, Executive Director, and the staff of OHSP, particularly F. DeRose and G. Stewart.

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1.0 INTRODUCTION

The intent of the project reported here was to attempt, in concert with the OHSP staff, improvement of the management, reporting, and evaluation activities of the OHSP operation. The basic assumption was that developments pertinent to such activities from management science and highway safety research were adaptable to the practical requirements of OHSP. The strategy devised to attempt this improvement in operations was evolutionary, not revolutionary -- the approach elected was not that of attempting to replace the existing OHSP operation with some radically different management system, but rather through study of the existing system to identify sub-operations that might be improved by introduction of appropriate management tools and findings of highway safety research. A major consideration in electing that evolutionary approach was the advent of the NHSB-developed Annual Highway Safety Work Program (AHSWP), creating the additional ground-rule that recommendations from this project should be consistent with the features and requirements of the AHSWP.

Given those assumptions and guidelines, the desired focus of the project was identified as OHSP evaluation operations. This identified concentration on evaluation operations reflects recognition of the degree to which evaluation permeates and, to a very large extent, determines all other OHSP operations. The act of identifying Michigan's highway safety posture and problems and of forming the Michigan Highway

Safety Plan is evaluation; selecting appropriate countermeasure efforts and developing action agency project proposals is evaluation; monitoring action project objective approximation is evaluation; and, completing the cycle, review of project and total program impact on the Michigan highway safety problem is evaluation. Thus, in a very real sense, the primary function of OHSP is evaluation.

With the limited scope of the project proposed, it was jointly recognized that simultaneous attack on all those evaluation operations was not practical. Rather it was the joint conclusion of OHSP and HSRI that a synthesis approach was indicated, starting with review of evaluation activities of individual countermeasure action projects, followed by consideration of evaluation problems with groups of functionally similar projects, and finally identification of evaluation operations appropriate to the complete mix of projects.

The sections that follow describe the activities of HSRI in pursuing that evaluation study paradigm. Section 2.0 summarizes our work with evaluation needs of the variety of current, individual action projects managed by OHSP. That summary treats our review of individual project plans for concurrent and final measurement and evaluation procedures for documenting approach to and achievement of project goals; our development, where proposed project plans were judged deficient, of evaluation measures recommended for the projects;

and our development, where it was possible, of measures common to groups of projects. Section 3.0 summarizes our involvement in developing the OHSP Program Structure, with particular attention to the effectiveness, volume and coverage criteria of the Michigan AHSWP. Finally, the discussion of Section 4.0 summarizes the general conclusions and recommendations derived from the study.

2.0 PROJECT EVALUATION

A recognized, immediate, and very basic need in developing a comprehensive statewide highway safety program is the injection of structured evaluation activities into current action projects. In order to allocate resources to obtain the greatest benefit, information concerning the effectiveness of past projects is essential. Unfortunately, action projects are usually devoid of the structured, quantitative procedures necessary for appropriate evaluation.

This is, at least partially, a result of poor communication and interaction between highway safety researchers and highway safety practitioners. Directors of action projects often do not realize the importance of evaluation nor appreciate the function it has in improving highway safety efforts. On the other hand, the researcher, who is very aware of evaluation requirements for finding answers and refining efforts, frequently disregards the real world constraints of action programs and attempts to interject experimental designs and research paradigms not appropriate to the thrust of a project. In any case, it is clear that a compromise between purity of evaluation measures and reality of action project efforts is needed. Therefore, steps were taken to become acquainted with ongoing projects and to formulate evaluation measures which could be useful as data gathering tools now without altering the actual workings of the projects.

First efforts in this regard involved a review of all on-going projects using 402 funds in the Office of Highway Safety

Planning. The principal inputs to this review were the summary folders for each project on file in the OHSP. These project folders include the original proposal, quarterly reports, a continuation proposal for projects beyond the first year, and any correspondence between project directors and the OHSP which might affect project functioning. In addition, a project folder might contain comments concerning problems noted by the OHSP fiscal or audit reviewers and the steps taken to alleviate them. Thus, these folders contain much pertinent, qualitative information useful in getting a grasp on project thrust.

Upon review of the project folders and discussion with the OHSP staff, brief one or two page summaries were written for each project. These summaries included such things as project title and number, cost, a listing of the original goals or objectives of the project and a reiteration of the project evaluation proposed. In those cases where a continuation application was available, the goals and proposed evaluation included therein were also included in the project summary. The resultant project summaries were used for an evaluation review.

The mechanism for evaluation review involved having "experts" in traffic safety and research methodology review the individual projects and recommend evaluation activities that were felt to be (1) pertinent to stated or implied

objectives of the project, and (2) practical for implementation by project personnel with no significant increase in project effort.* Due to time constraints, each project was reviewed by only one expert--however, except for the Driver Licensing (DL) functional area, all projects in a given functional area were reviewed by the same expert.

In conducting his reviews, the reviewer was requested to generate several types of output relative to each project.

1. His opinion of project merit, i.e., given that the project is completed as planned, what is the probable impact on highway safety as inferrable from previous projects?
2. His recollection of similar projects, particularly with respect to pitfalls and difficulties, and as potential sources of information for the project directors.
3. His ideas on potentially fruitful modifications of the present plans of the project, and ideas on new, related projects, and finally,
4. His recommendations on structured evaluation activities and products.

*The "experts" who performed the review function are identified in the Acknowledgments section of this report.

The actual review of individual projects was accomplished almost exclusively by reference to the summaries of project information available and by query of OHSP staff or project files when specific questions arose. Due to time constraints, direct contact with action project personnel was accomplished in only a few cases, with such contact invariably for information on some specific aspect of the project.

Those, then, were the ground rules under which the specific project evaluation reviews were undertaken. As would be expected, the reviews that resulted showed considerable variation due to reviewer differences, project differences, and variation in quantity and quality of information among the projects.

The "experts'" comments were compiled into a working paper-interim report for discussion with the OHSP staff. Subsequent to review and discussion it was agreed that the evaluation recommendations would be most useful if they could be broken down into specific questions to be answered by project personnel.

An intensive translation effort was then undertaken to transcribe the evaluation recommendation narratives into usable data-gathering forms which could be sent to project directors for them to fill out. In so doing a number of decisions had to be made in weighing alternatives. For example, the questions asked should be general enough where possible to compare projects in a given functional area. On

the other hand, each project has many unique characteristics which should be considered in evaluation. Secondly, it would be desirable to use a common evaluator such as change in the number of accidents as the critical measure. However, many variables enter any accident picture and the causal relationship between some effort and some change in the accident frequency is rather tenuous. Perhaps some quantitative measure of the effort put into a project, i.e., an "efficiency" measure, would be a better evaluation than trying to relate it to accidents. Thirdly, undue added burden on the project personnel is undesirable, but some pressure may be necessary to get more meaningful information. Fourth, some balance must be found between pure, unconfounded measures and data which is easily obtainable in a field situation but is too qualitative to be useful.

These and other less identifiable considerations entered into the formulation of forty-eight project evaluation questionnaires, effectively an individualized questionnaire for each of the OHSP projects listed in Table I. Examples of these forms can be found in Appendix I. It may be noted that the forms developed include both accident statistics and measures related to the day-to-day operation of a project. In many instances the forms contain some measures normally gathered by the project personnel, but which may not be organized in a usable manner. Also, some data may be requested which has not been gathered to date. In any case,

TABLE I. OHSP PROJECTS FOR WHICH EVALUATION FORMS WERE PREPARED

VI-69-1 (Dept. Educ.)
DE-68-3 (Pontiac)
DE-69-1 (Manistique)
DE-69-2 (Benton Harbor)
DE-69-3 (Dept. Civil Serv.)
DE-69-4 (Lansing)
DE-69-6 (Roseville)
DE-69-7 (Flint)
DE-69-8 (Plymouth)
DE-69-009 (Alpena et al)
DL-69-2 (Dept. State)
DL-70-001 (Dept. State)
DL-70-002 (Dept. State)
CL-69-1 (Dept. State)
AL-69-1 (Dept. St. Pol.)
AL-70-001 (Dept.Pub. Health)
AL-70-002 (Dept. St. Pol.)
IS-69-2 (Dept. Hwys.)
IS-69-3 (Dept. Hwys.)
IS-70-1 (Dept. Hwys.)
TR-69-001 (Dept. St. Pol.)
TR-69-5 (Dept. St. Pol.)
TR-70-1 (Dept. St. Pol.)

EM-68-2 (Dept. Pub. Health)
EM-69-4 (Fraser)
CD-69-3 (Saginaw)
CD-69-4 (Dept. Hwys.)
CD-69-5 (Taylor)
PS-69-1 (Troy)
PS-69-2 (Norton Shores)
PS-69-3 (River Rouge)
PS-69-5 (Lansing)
PT-69-4 (Sterling Hts.)
PT-69-005 Dept. St. Pol.)
PT-69-6 (Taylor)
PT-69-7 (Kalamazoo Twnshp.)
PT-69-8 (Wayne)
PT-69-9 (Westland)
PT-69-10 (Farmington)
PT-69-13 (Kalamazoo)
PT-69-14 (Oscoda Co.)
PT-69-15 (Farmington
PT-69-16 (Fraser)
PT-69-18 (Lansing)
PT-69-19 (Vicksburg)
PT-69-20 (Clinton Twnshp.)
PT-69-21 (Flint)
PT-69-023 (E. Detroit)

the information needed should be readily obtainable in nearly all instances and is deemed important enough to warrant some additional effort if necessary.

The evaluation forms are designed to serve two important functions. The one which has already been adequately suggested is to gather information pertinent to the planning operations of the OHSP. A second, somewhat more subtle, function is to motivate the various project directors to give more thought to evaluating their efforts themselves at the local level. If such a forcing function is realized the project directors will, hopefully, consider other evaluative measures pertinent to the local situation.

Finally, it should be noted that the project evaluation forms are not viewed as an end, but can and should be refined as the reaction of project directors is voiced and as better measures are formulated. For example, some of the measures suggested are general to a group of projects, such as police traffic services projects, while others are quite specific to particular projects. A continuing effort should be made, as feedback from project personnel comes in, to expand upon the general measures which can be used for inter-project comparisons.

3.0 PROGRAM EVALUATION

Until countermeasures can be evaluated, directly or indirectly, with some certainty in terms of crash reduction, decisions on what countermeasures are appropriate to what problems must remain largely subjective. As discussed in the previous section, attempting to relate individual countermeasure projects to crash variations is futile--the context, usually involving many crash reduction efforts operating simultaneously, just does not permit clean measurement of the impact of any one of the countermeasures. As reflected in the kinds of project evaluation proposed in Section 2.0, the logic adopted with individual projects is that countermeasures properly applied will have a desirable but unmeasurable effect and that evaluation must treat the excellence or efficiency with which the countermeasure project is operated.

Such an on-faith operation is perhaps acceptable with individual projects, but is hardly defensible with programs involving large numbers of countermeasure projects, where there exists, in addition to the need for crash-related evaluation to justify major fund expenditures the need to gain understanding of countermeasure effects for future planning.

This need for persistent directed effort to identify countermeasure impact is quite evident in the program structure concepts developed for NHSB by Peat, Marwick, Mitchell and Company (PMM&Co.) These program concepts, which are the basis for the NHSB Annual Highway Safety Work Program (AHSWP), provide structures for relating traffic system characteristics

with countermeasure program types with countermeasures individually defined to better correlate both with traffic system characteristics and with capabilities of action agencies responsible for operating the several types of countermeasure projects.

In preparation for developing program evaluation procedures, HSRI worked with OHSP to develop the Michigan AHSWP. After joint consideration of several possible countermeasure program structures, the program structure developed by PMM&Co. was selected as reasonable and adequate for Michigan needs.* Figure 1 shows the proposed OHSP Program Structure with the Program Elements arranged in a matrix of traffic system components and activities. Note that a tentative Program Element in the Comprehensive/Crash and Clean-up cell titled "Crash Reporting" has been added to the structure developed by PMM&Co. This element may become part of the OHSP structure to provide clear identification of crash investigation activities related to all characteristics of the crash situation.

While accepting the PMM&Co. Program Elements, considerable re-design of their Program Sub-elements was initiated both to mate the program structure to the Michigan needs and to provide for more explicit evaluation plans. Figures 2-6 show the derived

*This is the program structure developed by Peat, Marwick, Mitchell and Company as part of the National Highway Safety Program Management and Reporting System as developed by them for NHSB under Contract No. FH-11-6925.

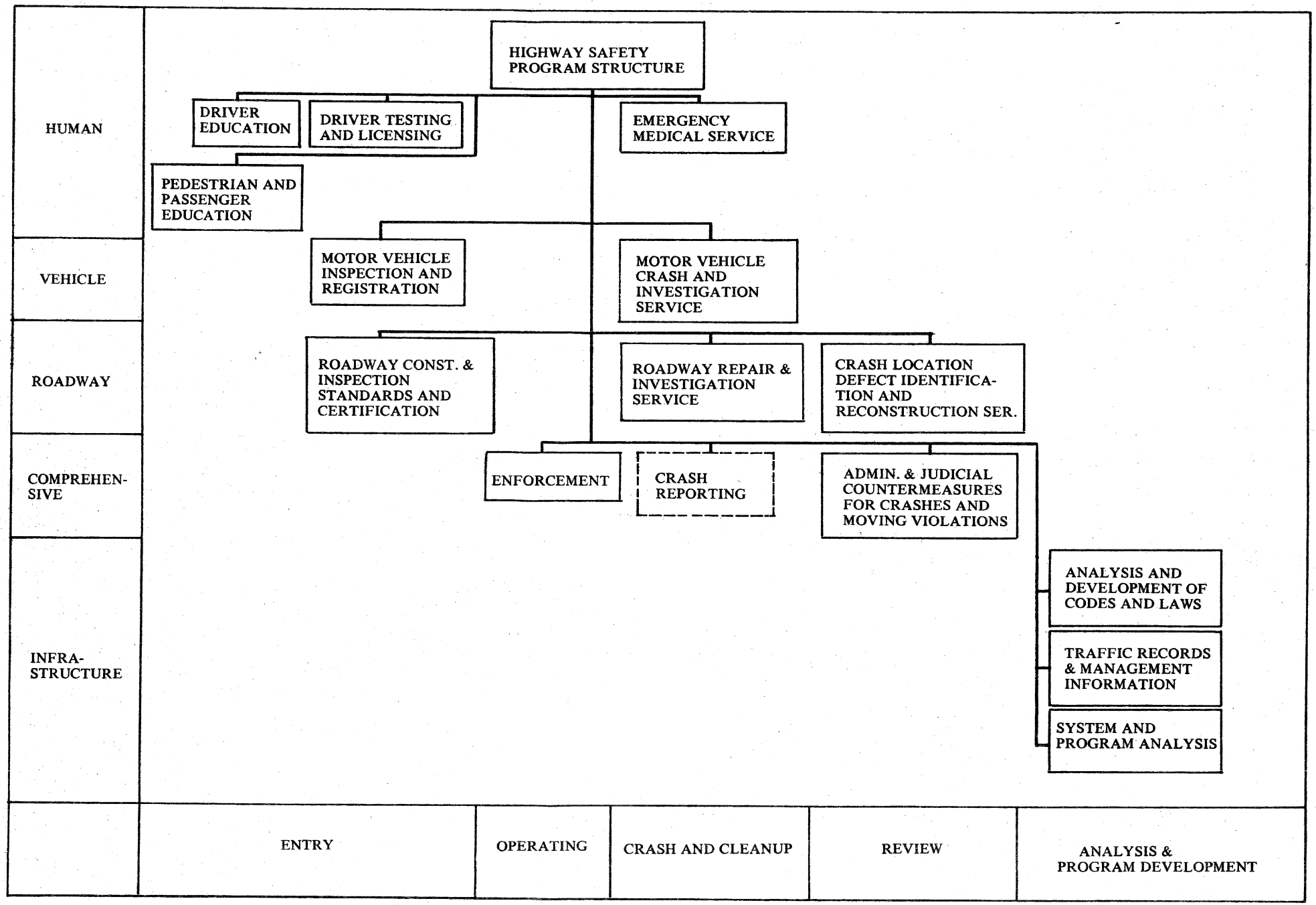

Figure 1. Proposed OHSP Program Structure

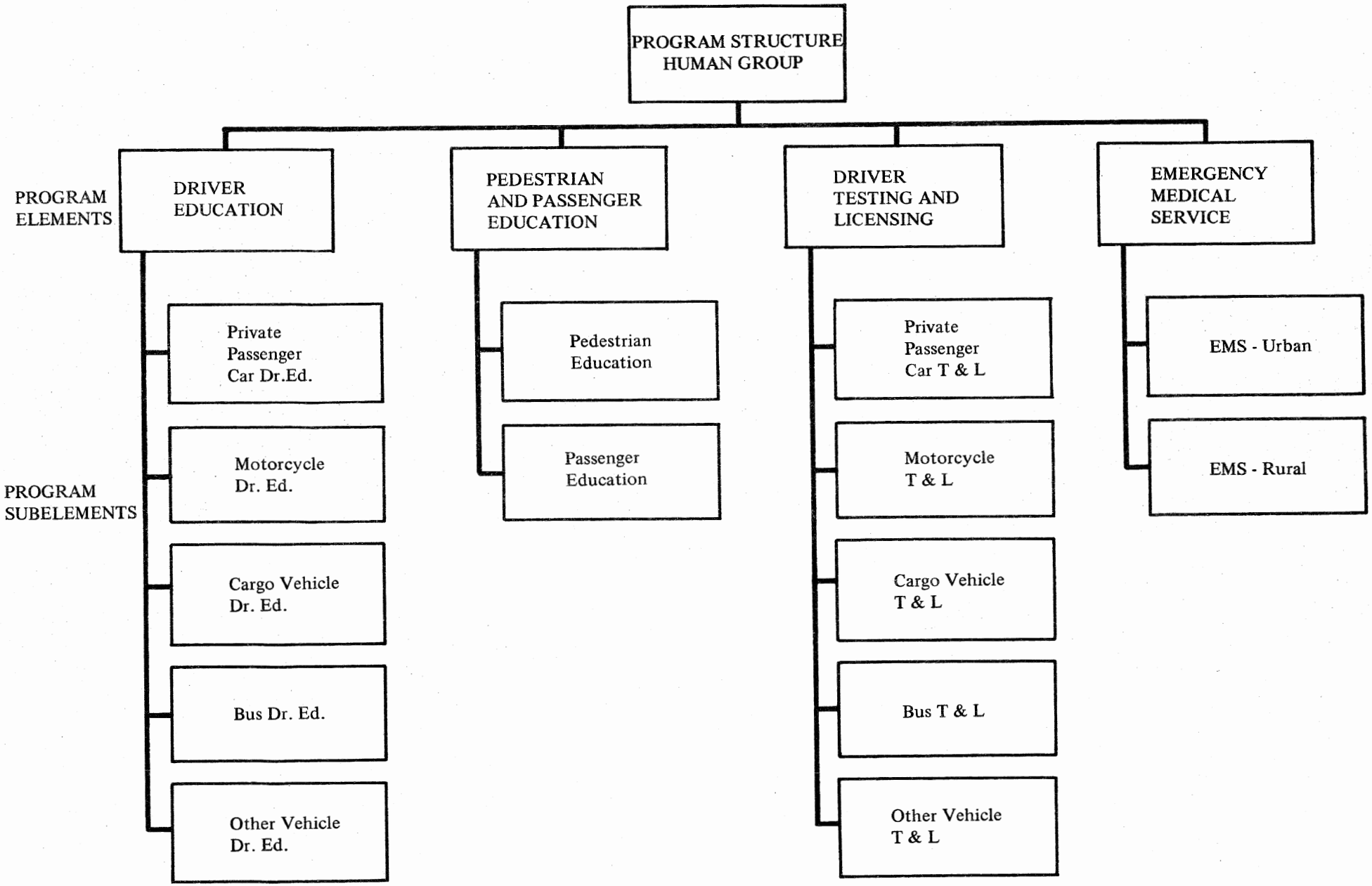

Figure 2. Human Group Program Structure

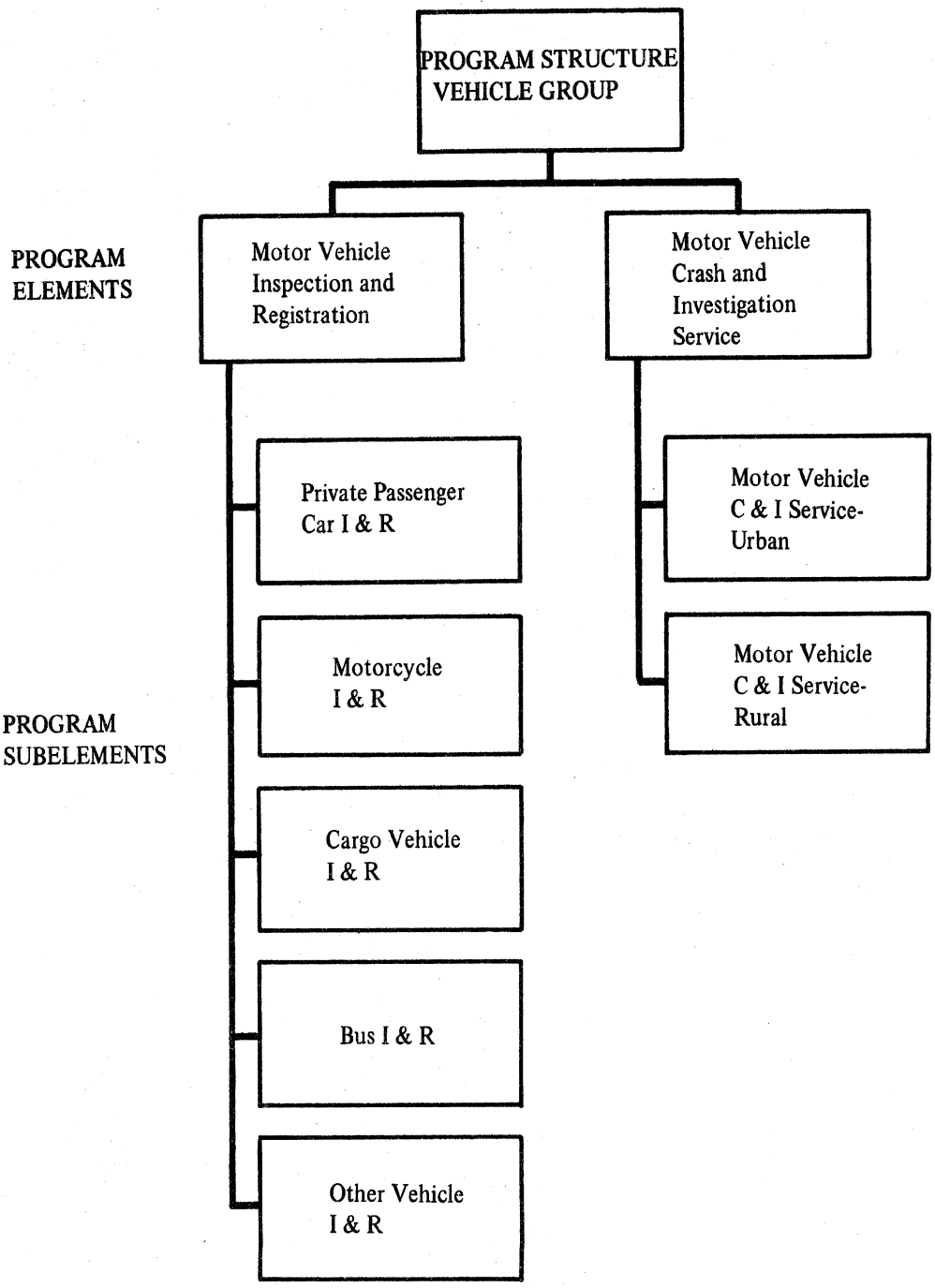

Figure 3. Vehicle Group Program Structure

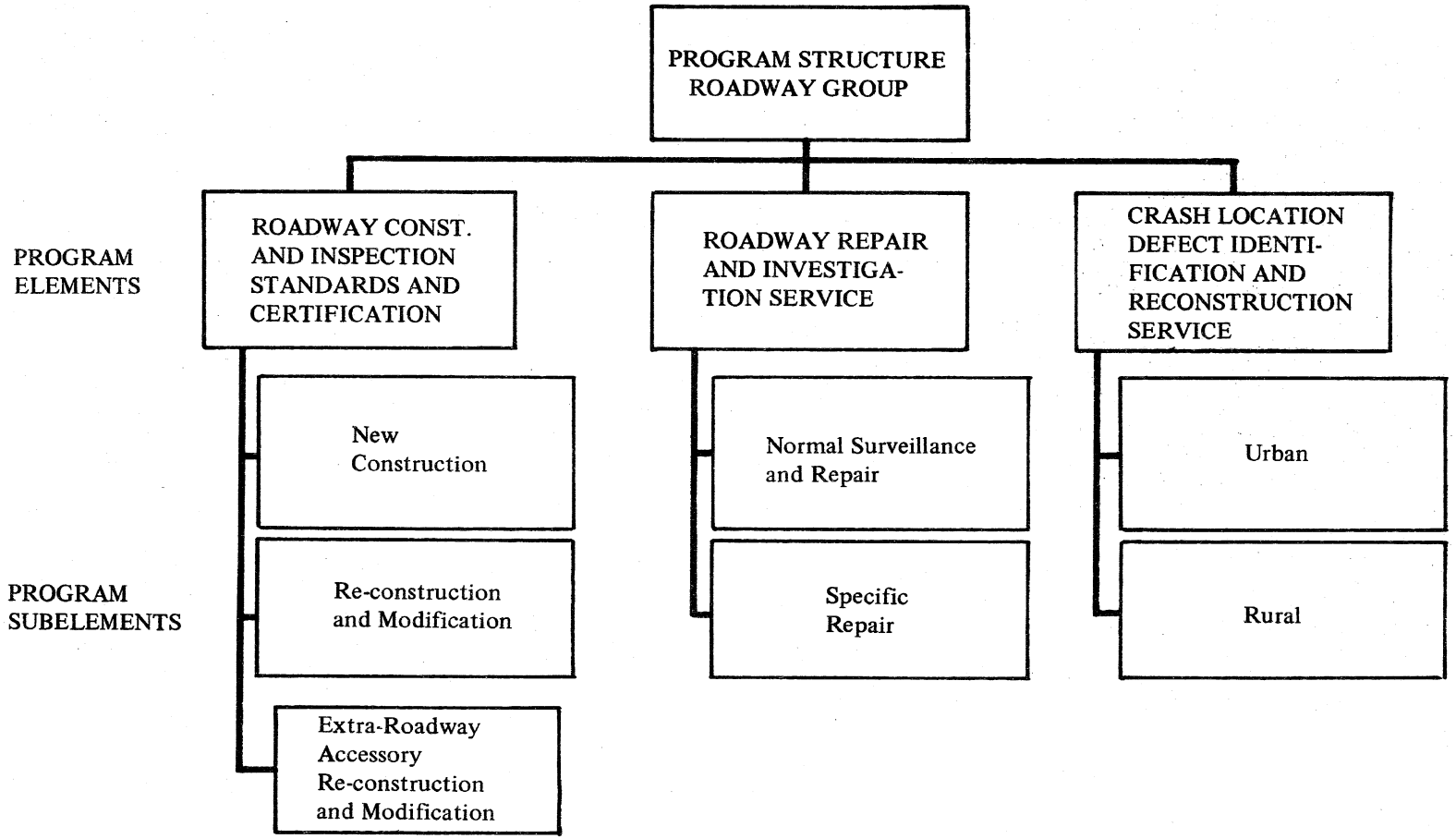

Figure 4. Roadway Group Program Structure

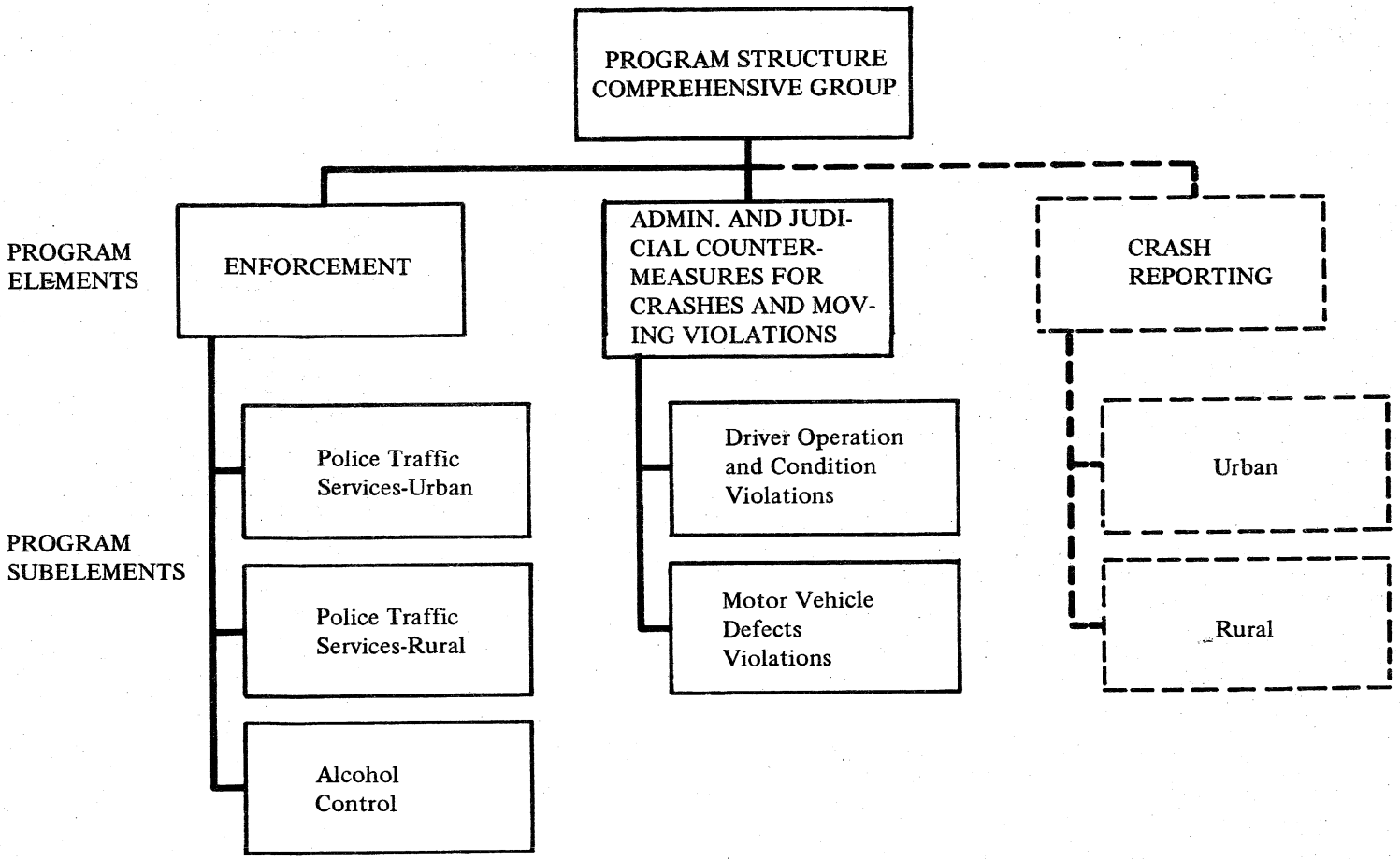

Figure 5. Comprehensive Group Program Structure

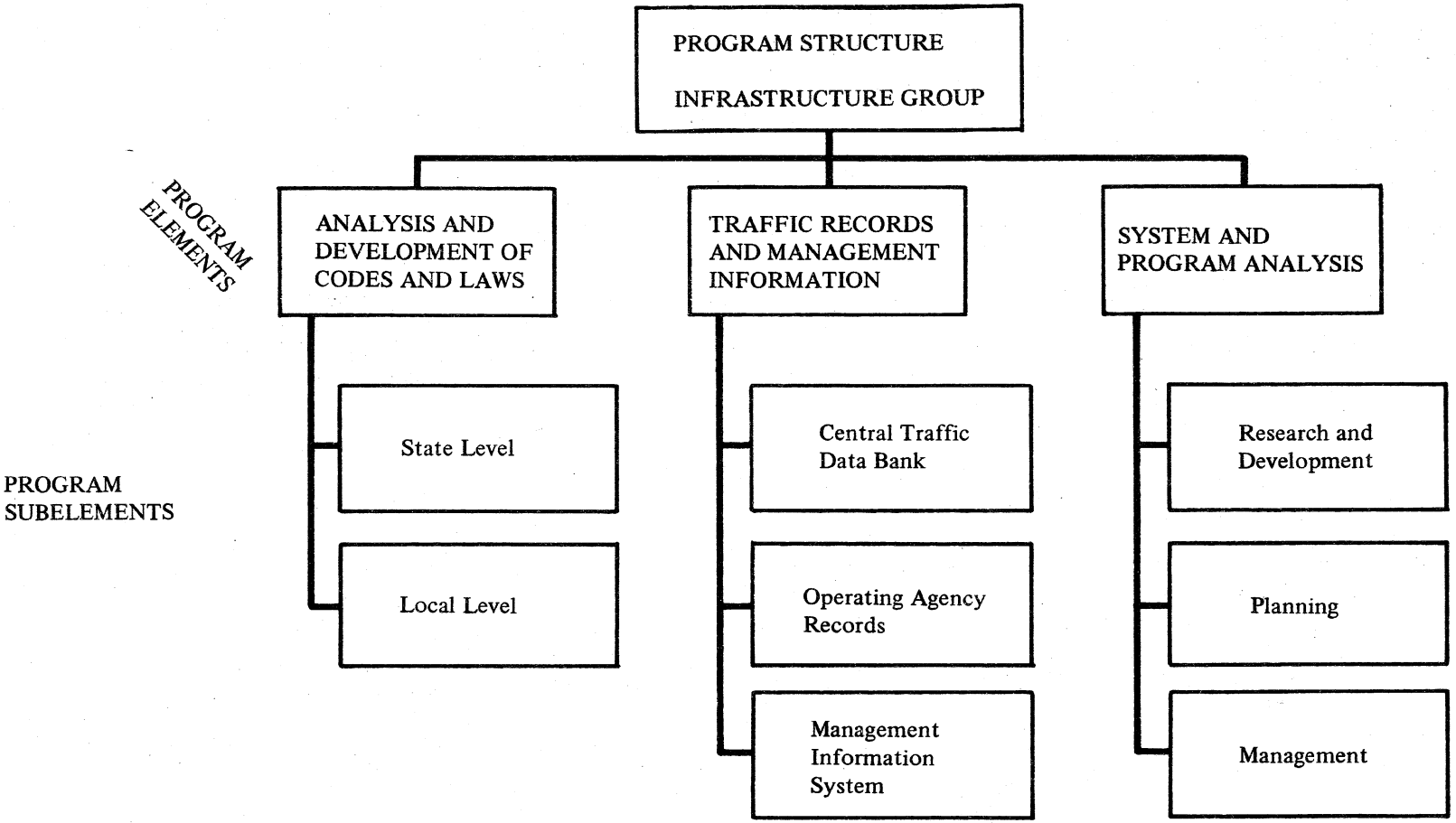

Figure 6. Infrastructure Group Program Structure

sub-elements broken out by system component groups.

As required by the AHSWP, each of the sub-elements in the program structure must have associated effectiveness and output criteria designed as indices of improvement for each sub-element. The discussion that follows treats some of the considerations involved in the HSRI development of the proposed sub-element criteria measures.

3.1 SUBELEMENT EVALUATION CONSIDERATIONS

The formulation of effectiveness and output measures for the Annual Subelement Plan involved extensive and intensive ruminations of alternatives. The highway safety scene involves a fantastically large number of variables contributing to the occurrence of crashes. Since each plays a role, the identification of potential countermeasures is practically infinite. Therefore, it is essential that planning and subsequent evaluation of a highway safety program focus on those options and relationships most directly related to crash reduction. Establishment of comprehensive state highway safety programs is a major step toward identifying top priority options and developing an evaluation of the efforts to deal with these options is the key to program improvement.

The set of Program Sub-element effectiveness criteria recommended to OHSP must be identified as results of considered, composite opinion--in virtually no instance can, particularly, the effectiveness measures related to crashes be documented with firm research findings or unequivocal operational experience. Rather, the measures proposed were evolved from many hours of discussion and, occasionally heated, debate between the authors, other HSRI staff, OHSP staff, and some NHSB staff. Attempting to reproduce all the considerations touched on in those discussions would be futile--the measures must stand on their own merits as interim indices. However, for illustration and in some cases expiation, the discussion that follows treats

some of the major considerations involved and briefly notes some of the specific thoughts generated in developing the proposed effectiveness measures.

Perhaps the major consideration, if any one can be so designated, was whether the data needed are available or can be gathered without too massive an effort. Certainly it is senseless to establish effectiveness measures which cannot be obtained without a major overhaul of the data collection machinery in the state. On the other hand, many of the measures most easily available are not applicable to the individual sub-elements of the present programming effort. In these instances, the measures recommended will probably force extended efforts on the part of project personnel and/or state agencies to include more relevant data gathering. At any rate, considerable thought was given to those measures which could tap present data sources for the appropriate information.

In some cases this may require a meshing of two or more data sources or a reorganization of data being stored. For example, the effectiveness measure recommended for the private passenger car sub-element of the Motor Vehicle Inspection and Registration Element calls for "Number of private passenger cars with equipment or registration defects versus total number of passenger cars inspected" and output measures involving "Percent of private passenger cars inspected." The first of these measures is obtainable from the data collected

at the check lanes by the Michigan State Police, but the latter requires the total number of registered private passenger vehicles in Michigan. This probably must be obtained from the Secretary of State's records. Thus some additional effort may be necessary to coordinate the individual data sources; however, the information is available in most instances in some state files.

An example of sub-elements probably requiring additional data gathering efforts is found in the Traffic Records and Management Information Element. Turn around time for system inquiries and average response times to information requests are measures probably not being made right now by the agencies responsible for various data banks. The diffuseness of this infrastructure element necessitates proxy measures obtainable at the input-output juncture between agency information and information users. Here, then, the effectiveness measures recommended force the gathering of relevant data that are in all liklihood not presently available.

Considerable attention was also given to the trade-off between crash-related measures and proxy measures. Effectiveness criteria relating sub-elements to change in the incidence of crash types that they are aimed at reducing is desirable, but the identification of particular cause-effect relationships is often tenuous at best. When it is not possible to identify crash characteristics showing a reasonable relationship to sub-element efforts, proxy measures of effectiveness

should be used. Again, the Traffic Records and Management Information Element is a good example of the recommendation of proxy effectiveness measures because there is no close connection apparent between this program aspect and specifically identifiable crash types. It may be noted that quite a number of the sub-elements have just such proxy criteria suggested.

The complete set of sub-element effectiveness and output measures are found in Appendix II. While there may be some equivocality in these measures, there is no question about their heuristic value. It is unfortunate but true that the present state-of-the-art of highway safety does not contain any unequivocal cause-effect measures which can be used to relate a specific countermeasure to the reduction of particular segment of all highway crashes. The measures suggested here however, have the value of gathering data and guiding efforts as more unequivocal relationships are uncovered and inputting this information into an improving state-of-the-art.

The output measures suggested in Appendix II are self-explanatory in relation to the sub-elements. They simply reflect the volume of the effort and relative coverage of the target component/phase combination identified by the sub-element. The effectiveness measures, on the other hand, are designed to identify whether or not the sub-elements are achieving the planned reduction of specific crash threats. While many of these are self-explanatory also, it may be desirable to reflect on some of these measures element by element.

3.2 SUBELEMENT EFFECTIVENESS MEASURES

Passenger and Pedestrian Education Element

The sub-elements subsumed under this element, pedestrian education and passenger education, are unique and require individual evaluation measures. While it is recognized that a number of causative factors enter into each accident, a pedestrian-vehicle encounter is generally designated as faulting the vehicle driver or the pedestrian. Therefore, data found in the accident reports are useful in placing "fault" with either driver or pedestrian. It is hoped that efforts identified by this sub-element would reduce crashes in which pedestrians are at fault. An effectiveness measure of "Number of pedestrian crashes with pedestrian at fault versus total number of pedestrian crashes" should indicate a decreasing ratio of "pedestrian faults" to total pedestrian accidents and perhaps also a decrease in the total as the program increases its effectiveness.

Parenthetically it may be noted that although pedestrian accidents obviously involve more than just elementary school children, the output measures were directed at this level for now as it is the only segment at the moment in which identifiably "pedestrian" education courses occur.

The passenger education sub-element is difficult to define and identify. It may take the form of first-aid training, perhaps a defensive driving course, possibly mass media information efforts, or numerous other possibilities. At any rate, "Number of passenger fatalities and injuries versus total number of fatalities and injuries" should reflect a relative

decrease if passenger education is effective. This could be a result of passengers influencing the driver to be more careful, thus decreasing accidents involving passengers or more effective first aid efforts may reduce fatalities. The causes, thus, are multiple but an effective passenger education campaign should be reflected in reduced passenger fatalities and injuries.

Driver Education Element

The Driver Education Element was broken down into sub-elements indicative of classes of driver/vehicle combinations probably affected by various "driver education" efforts. This kind of a breakout follows through directly to driver licensing classifications by type of driver. Although this yields sub-element driver categories (i.e., private passenger car, motorcycle, cargo vehicle, bus, and "other") the common effectiveness measure is number of "trained" drivers in each particular classification involved in crashes versus the total number of crashes for that class. Obviously, effective education of a class of drivers should result in fewer trained drivers in accidents of that particular group of drivers and as training becomes more universal this will also tend to reduce total accidents of a given sub-group.

Note that this element is aimed at the education of new drivers in any certified driver education course whether commercial or associated with a school system. This does not include remedial schools for high accident or high violation drivers as that is more directly associated with the Administrative and Judicial Countermeasures for Crashes and Moving

Violations Element. Rather this element includes the new drivers entering the system for the first time.

Driver Testing and Licensing Element

This element is directly associated with the Driver Education Element in the sense that it consists of the same driver/vehicle combination sub-elements and is, essentially, the entry point for new drivers into the highway system. Also, of course, renewal of licenses is handled here. Consequently, it is at this point, at least in theory, that a filtering of physically or mentally inadequate drivers occurs through applicant testing.

Appropriate effectiveness measures, then, should involve some quantification of number of rejections and number of acceptances per total number of applicants. However, it is not completely clear if improved driver testing and licensing activities will be reflected in a reduction or an increase in the ratio of rejections to total applicants. Arguments can be made, and have been made, for both viewpoints.

The most accurate position is realized if the entire traffic safety system is considered and the testing and licensing aspect is viewed in perspective as a functional part of the system. If, in fact, other aspects of the system are improved then holding the rejection ratio constant or increasing it should result in a continual improvement of the driving population. Only if rejection rate drops should there be a possibility of any decrement in driver quality, and even then this is true only if rejection rate decreases faster than other

aspects of the total system are advanced. Thus, improvement in the highway system can be realized, theoretically, by either a constancy or an increase in the rejection ratio. A decrease in the rejection figure might be cause for a re-assessment of the Driver Testing and Licensing Element.

It is evident that this particular effectiveness measure is more or less one of default and is not particularly satisfactory. This is, unfortunately, a reflection of the state-of-the-art driver testing and licensing. It is generally recognized that the tests given are not very indicative of driving ability although the visual and other physical exams may remove the most severely handicapped from the highways. Until the testing and licensing function is more rigorously defined and until the tests are more rigorously applied, this effectiveness measure serves as a reasonably good interim index of element effectiveness.

Emergency Medical Service Element

In recognition of the functional differences of operating an emergency medical service in urban areas as opposed to rural settings (e.g., number of miles covered, frequency of accidents, hospital access), this element is broken down into rural and urban sub-elements. However, each has the same effectiveness measure "Number of injury victims subsequently listed as fatalities versus total number of injury victims." This is appropriate to both sub-elements although the subsequent figures may be quite different due to functional differences of rural and urban settings mentioned above.

Comparison can be made, utilizing these criteria, between rural and urban service to indicate in a gross way where best to allocate resources in the future. Furthermore, similar parallels within the rural and urban sub-elements will indicate need for a redistribution of equipment and effort throughout the state.

Adequacy of emergency medical service involves considerably more than average response time on the part of ambulance companies. Training received by the ambulance attendants, availability of appropriate extrication and other life saving equipment, and first aid efforts by policemen are examples of other aspects of emergency medical care. Effectiveness measures should reflect this multi-factor situation. Thus the recommended measures consider the relative number of accident victims who die sometime after the crash as compared to the total number of persons injured. This excludes those victims who are killed immediately since no level of emergency service can affect their survival, but include deaths occurring after some assistance has arrived. The resultant measure will be a comparison of those accident victims listed as injuries by the investigating patrolmen and coroners statistics on subsequent deaths. This figure should decrease as emergency medical service is improved.

Motor Vehicle Inspection and Registration Element

The causal relationship linking vehicle inspection and registration with highway crashes is very tenuous at this point. Instead, it is clear that proxy measures of effectiveness are more appropriate for this element than any attempt to link

inspection or registration with crash frequency. Utilizing the same sub-element breakdown used in Driver Education and Driving Testing and Licensing, separation by vehicle/driver type, proxy measures relating number of vehicles with equipment or registration defects with total number of vehicles inspected is recommended. Thus, as check lane activities increase and more vehicles are inspected, it will still be possible to compare ratio of defective vehicles to total inspected from year to year by type of vehicle.

As the highway program becomes more effective there should be a decrease in the ratio of defective vehicles found on the roadways. Also, any striking differences in these figures between sub-elements would be an indication that increased efforts might be directed toward particular vehicle classes.

Motor Vehicle Crash and Investigation Service Element

Efforts appropriate to this element of the highway safety system are similar to those required of emergency medical service since a basic requirement is on-scene action to prevent subsequent worsening of crash consequences. In this particular instance the appropriate action is to prevent second crashes into debris left from an initial accident and to undertake police investigation. Sub-elements similar to those found in the Emergency Medical Services Element are proposed -- rural and urban -- in recognition of basic differences such as number of police units available, road miles covered, availability of wrecker service and traffic density.

"Number of crashes involving previous crash debris or blockage versus total number of crashes" is a measure pertinent to both sub-elements, however. Effective efforts in this element of the state program should result in decrement of the ratio of second-crash accidents to total crashes.

It is evident that this effectiveness measure does not include the investigation aspect of the present element. This was done for two reasons. First is the immediate importance of clearing the area of debris or blockage so as to prevent subsequent crashes. This is a primary need following a crash, with investigation being undertaken only after this is accomplished. Secondly, effectiveness measures of crash investigation may be more appropriately included in a separate Crash Reporting Element as indicated in Figure 1. Consequently, these considerations and the undesirability of two effectiveness measures led to a concentration on the debris clearance problem. In addition, the crash debris aspect is quite directly linked to the prevention of other crashes whereas crash investigation is more appropriately part of the comprehensive or infrastructure segments and only loosely linked causally to crash factors.

Roadway Construction and Inspection Standards and Certification Element

This element is another case in point for which the causal link between road construction factors and crash occurrence is too weak to justify effectiveness measures related to crash reduction. The proxy measures most appropriate are based on already existing American Association of State Highway Officials

standards. Reference to this element in Appendix II shows that the effectiveness measures recommended simply involve the amount of compliance to these established standards for new construction, reconstruction and modification of existing roads, and the signs, guardrails, etc. accompanying the roads.

Roadway Repair and Investigation Service Element

Road repair and investigation services have two basic elements; regular surveillance and repair work resulting from normal wear or minor crashes and specific crash site repairs. These form the sub-elements for this segment of the highway program structure.

The effectiveness measures proposed for these sub-elements indicate the relation of repair needs discovered during normal road surveillance by highway crews and repair needs due to a crash that are reported. Relative to total repairs the former measure should decrease and the latter measure will increase as communication improves between the highway agencies and other official agencies regarding crash site repair needs.

Crash Location Defect Identification and Reconstruction Service Element

The primary thrust of this element is to locate sites having a high frequency of accidents, detect and identify environment defects at that site and rectify the defects. The hoped for result, of course, is a reduction in the frequency of crash occurrence at those particular locations. An appropriate effectiveness measure, then, is the "number of crashes at identified repeat crash sites versus total number of accidents."

An identified repeat crash site may be defined as any location which is known to have had more than one accident during some time period, like a year. That, of course, is hardly a satisfactory criterion in itself; however, a number of sites are undoubtedly known to local and state highway officials that have a recurrence of accidents each year well above two or three. Utilizing this information one could choose, say, five sites having the greatest frequency of accidents and take efforts to correct defects (as identified by a qualified engineer or engineering team) at these sites. Recycling the process then as funds permit, results in applying counter-measures to other sites having frequent crashes. As a result, reduction in the number of crashes occurring at any given site should occur as the more severe locations are corrected and ultimately a decrease in the number of repeat accident sites may be realized.

Enforcement Element

As part of the comprehensive segment of the program structure, this element obviously includes numerous functions scattered throughout the entire highway system. This multiplicity of function increases the difficulty of identifying useful sub-elements without specifying an unrealistically large number of individual problem areas. Indeed, the comprehensive elements of the program structure can be separated into so many sub-elements as to lose all utility. A reasonable compromise is to signify urban and rural police traffic services

as sub-elements on the recognition that the police are the principal enforcement unit and, again, that the urban and rural breakout is a useful division of differences in territory covered and duties performed. In addition, a separate sub-element for alcohol control has been noted mainly by virtue of the emphasis being placed on this aspect of the problem by the NHSB and other federal agencies.

The effectiveness measures for this element are self-explanatory. They are simply measures of the relationship of enforcement efforts to number of vehicle crashes.

Administrative and Judicial Countermeasures for Crashes and Moving Violations Element

This is the second of two elements included as "comprehensive" units in the program and, as such, also reflects a multitude of factors throughout the highway system. For example, remedial driving courses, the Department of State's "point" system and the courts are segments of this element. Attempts to determine effectiveness measures to reflect each or all of the sub-elements quickly became unwieldy, as did, for that matter, simply delineating all sub-element possibilities. Consequently, attention was focussed on what is probably the core of an administrative and judicial countermeasure, the courts.

Reasonable sub-elements can be derived from the courts' functions and, subsequently, driver operation and condition violations was chosen as one aspect while motor vehicle defects violations is designated as the other sub-element. In this way

effectiveness measures can be applied individually to these separate points much as, we suspect, the courts' view the violations in different levels of importance or severity.

An even more difficult task for this element was to define the effectiveness measures. Partially due to the comprehensiveness of the element, it is particularly awkward to specify measures which reflect only the administrative and judicial efforts while excluding other related factors such as action or inaction of police or other agencies.

"Number of moving violation conviction repeaters versus total number of moving violation convictions" is a measure of driver violations which is relatively free of confounding by external efforts. While it depends on police action, of course, a measure of the ratio of repeat violations to total violations should not be influenced by increased or decreased police efforts since total violation cases will also reflect altered effort. Focus on relation of the repeater convictions to total convictions places attention on the effects of court action on subsequent violations. It is expected that improved efforts for the sub-element may be seen as an increase in this ratio initially, but over some years the ratio of "conviction repeaters" to "total convictions" should decrease if administrative and judicial countermeasures have remedial or preventative effect.

The measure suggested for vehicle defects, "Number of vehicle defects repaired versus total number of vehicle defect citations issued" may require additional data gathering. At any rate, if follow-up is not now a part of the present program it should be and this effectiveness measure can be used as a forcing

function in this regard.

Analysis and Development of Codes and Laws Element

Principal sub-elements appropriate to this element include efforts involving state codes and laws and attention to local codes and law. As with the Roadway Construction and Inspection Standards and Certification Element, reliance must be placed on some external standard since the crash-cause relationship is too tenuous for effectiveness criteria within the accident picture. Hence, effectiveness is best measured by compliance of the state and local laws to the Uniform Vehicle Code and Model Traffic Ordinances.

Traffic Records and Management Information Element

Although the element title noted here indicates an identifiable problem area, the scope of the element is broad and includes a number of data banks and information sources. For example, data stored in the Departments of Public Health, Highways, State Police, and the Secretary of State's Office, with all of their attendant information sources are relevant aspects of this element.

To effectively handle this element three sub-elements are noted: Central traffic data bank, operating agency records, and management information systems. The first of these is essentially the Michigan State Police accident data bank and its vast computer hardware. It is designated as a sub-element for its control of highway crash data and the role it plays, and is expected to play, in distributing crash data to all state and local agencies. The effectiveness measure involves

the time lag between information inquiries and the placement of the information requested before the query initiators in relationship to number of total system inquiries. Thus, a measure of total information requests and average response time will be available. As the system becomes more respondent to needs number of inquiries will probably increase, but later an increase or decrease may occur depending on persistence of users, goodness of information, speed of response, etc. At any rate, this measure will afford a time trend which should reflect a decrease in average turn around time between information requests and response as the system gains efficiency.

Operating agency records, such as the Highway Department and Secretary of State's office, are more responsive to internal, that is, agency initiated inquiries. This is a functional difference from the accident record data and one might expect less fluctuation in total number of system inquiries. System effectiveness will be reflected in average response time to information requests.

The management information system sub-element is conceived as the summary information used by management, in Michigan this is the OHSP, for its planning, programming and managing functions. This includes information and data from all of the above sources at one time or another. Thus, effective operation entails increased "automatic" input of pertinent information summaries from each source to the OHSP and a decrease in the number of specific requests for data necessary on the part of management. In other words "Number of safety system parameter files coupled to central management

versus total number of safety system parameters" should be an increasing proportion.

System and Program Analysis Element

The third infrastructure element and the final program structure element to be considered is essentially the OHSP management function. One can conceive of this as the apex of the pyramidal highway safety system structure controlling, or at least integrating, the other elements. As such, an effectiveness measure must include every highway safety function and operation and it must include the entire state. Two such measures are available; fatalities and total crashes. Fatalities should show a decrement as both number of crashes and severity of crashes are decreased, while total crashes do not reflect any change in severity. Thus, number of fatalities was chosen as the more central and inclusive statistic. In order to compensate for increased vehicle miles this can be expressed in relationship to the State's best estimate of total vehicle miles, thereby resulting in an effectiveness measure of "Number of fatalities versus total vehicle miles."

This element was also divided into functional sub-elements of research and development, planning and management activities with the above effectiveness measure applied across each sub-element. The output measures suggested reflect these three functional efforts (see Appendix II).

These, then, are just a few of the innumerable considerations involved in attempting to assist the OHSP develop a Annual Highway Safety Work Program pertinent to the needs of

Michigan. The resulting program structure and the effectiveness and output measures are, we feel, functional and reasonable. Although the measures recommended are not unequivocal under scientifically rigorous scrutiny, they are very basic data gathering tools to input program improvement and in turn can be refined as the state-of-the-art matures.

4.0 SUMMARY

The purpose of this project was to assist the OHSP in improving their management, reporting and evaluation operations. The resultant efforts, as noted in this report, consisted of two related but identifiably independent attempts to effect an improvement in the evaluation activities necessary and crucial to the management and planning of Michigan's highway safety program.

One such identifiable aspect was the formulation of specific project evaluation forms which could be utilized to improve the reporting and evaluating of project activities. Based on comments and suggestions by highway safety research "experts" extensively trained in evaluation and research techniques, individual forms were prepared which could be sent to forty-eight ongoing traffic safety projects. The measures suggested include both accident data and measures reflecting the day to day project operations and the efficiency with which the project is operated. The latter measures are viewed as most meaningful at this point in traffic safety state-of-the-art primarily because accident statistics are not causally linked to specific tasks in a close enough manner to reflect probable success of the project efforts. In other words, so many unaccounted variables exist in any specific traffic situation and location that being able to show a change in the accident picture due to some very finite effort is highly improbable. Accordingly, measures of efficiency and effort expended are a major part of an honest attempt to evaluate specific projects.

The second aspect of the present effort consisted of assisting the OHSP in formulating effectiveness and output measures for the newly initiated Annual Highway Safety Work Program. The evaluation measures subsequently recommended are more reflective of crash data than was possible in the individual project evaluation forms. While it is pessimistically held that the finite projects are too limited in effort to reach fruition in measurable local crash data, it is concluded, at least tentatively, that we should and can be justifiably optimistic about finding improved statewide accident statistics as a result of a planned, integrated statewide program. Consequently, the effectiveness measures formulated for the program elements are dependent mostly on traffic safety data and to a lesser extent are based on proxy measures which are presumed to have a major effect on some aspect of highway safety.

It is to be noted, finally, that neither the individual project evaluation forms nor the effectiveness and output measures recommended for the Annual Work Plan are end products. Quite the contrary, these are interim efforts that should serve as inputs to refinement and alteration as the system matures. The individual evaluation forms, for example, are data collection bases for the extraction and synthesizing of more general evaluation forms applicable to groups of projects and eventually to all projects perhaps. Similarly, the Annual Work Plan measures of evaluation are far from total equivocality and, that being the case, require ongoing refinement effort as the state-of-the-art advances to more answers.

APPENDIX I

SAMPLE PROJECT EVALUATION FORMS

Included in this appendix are three of the evaluation forms developed for individual OHSP projects. Illustrated are the kinds of predominantly effectiveness or efficiency measures believed useful both to OHSP and to the individual project directors. Forty-eight such forms were delivered to OHSP.

PT 69-21

Police Traffic Services - Flint

Evaluation Suggestions

As the major project within the community police traffic services area, the Flint project is the most carefully planned and consequently contains explicit evaluative considerations. Some "methods" of evaluation are noted in the original grant application including, (1) officers daily activity report, (2) daily traffic summary of accidents and enforcement, (3) personnel work report, (4) monthly summary for individual officers, (5) a shift summary and, (6) periodic posting of observers to tabulate traffic law violations (particularly before and after concentrated enforcement by the Selective Enforcement Unit). These evaluative methods are certainly quite desirable simply in terms of auditing project activities for appropriate manpower allocation as well as to map progress toward accident and violation reduction goals of this project.

It is noteworthy also that the quarterly narrative reports exhibit significant attempts to evaluate and direct the project through the use of objective data gathering methods. Attention has been given to meaningful record keeping so that the information can input to selective enforcement considerations. The grid system used to coordinate the selective enforcement activities in Flint has apparently been an effective tool which might be productively introduced in other jurisdictions. In any case, the grid has proven effective in Flint to distribute the enforcement in high accident locations.

The quarterly reports also indicate that attention is given to the time of day that greatest accident frequencies occur. However, it is less clear if the selective enforcement unit is assigned to correlate with times or days of high accident frequency.

If this is not being done it should be.

Another interesting aspect is the mention made in the original proposal that patrol officers will be posted to "observe" violations before and after strong selective enforcement. This is a good "before-after" measure to determine the effects of a strong selective enforcement effort, but no indication was given in later reports that this was ever carried out. We suspect that it was not. This type of measurement could be an indicator of immediate effectiveness of selective enforcement input, would supplement measures taken on the ultimate goals of accident reduction and should be utilized if manpower is available to do so.

The data gathered for evaluation purposes are quite comprehensive and appear adequate for the most part. A few measures will be suggested here which may be useful to indicate possibilities of more efficient manpower deployment or other ways in which this project might expand.

Evaluation Plan

I. Ultimate Performance Factors

A. Safe Transportation

The crash data collected in this project is comprehensive and well utilized for selective enforcement. It appears that monthly summaries are being prepared to guide manpower deployment. This might be augmented with similar weekly and daily summaries to see if this would allow quicker response to high accident locations, times or types of violation.

B. Efficient traffic flow

1. Estimated accumulated vehicle-miles travelled in jurisdiction during year
2. Vehicle miles per crash
   total _____
   fatal_____
   injury_____
   non-injury_____
3. Number of traffic control devices (e.g., stoplights, stop signs, etc.) (enumerated by grid if possible)_____

4. Number of traffic control devices per mile of streets per grid _____

II. Measures of Operational Effectiveness

A. Frequency measures

1. Manpower allocation

task	No. of men employed	total man-hours expended
normal police traffic services	_____	_____
selective enforcement plans	_____	_____
crash investigations	_____	_____
public education	_____	_____
formal training	_____	_____
routine training	_____	_____
planning and administration	_____	_____

2. Action programs

Again, the crash data presently gathered is quite complete. Some additional bookkeeping type measures may be meaningful.

number of hours of patrol_____

number selective enforcement plans active_____

number selective enforcement plans conducted_____

number of citizen complaints_____

number of convictions obtained_____
(enumerate by type of violation)

number traffic control devices installed this quarter_____

number traffic control devices altered or removed this quarter _____

3. Public education (indicate any public education programs undertaken this quarter)

4. Training

   Indicate formal training received by men in unit and number of men trained_____

   Indicate routine training given Selective Enforcement officers_____

5. Is any of the expertise of the Selective Enforcement Unit used to train other police officers? If so, explain.

6. Planning and administration

   Number of planning projects undertaken_____

   Man-hours devoted to planning_____

   Man-hours devoted to routine administrative chores_____

7. Equipment utilization

   Indicate equipment used in this project and number of hours operated_____

   For equipment used in routine traffic services and selective enforcement note number of citations made in connection with its use where possible_____

B. Efficiency measures

1. Action Operations

   _____man-hours expended by unit per citation

   _____man-hours of total unit operation per man-hour of patrol work

   _____man-hours expended by unit per man-hour of selective enforcement

   _____man-hours expended per crash investigation

   _____average response time to an accident

   _____number of citations issued per conviction obtained

2. Public Education

   If public education (schools, civic groups, etc.) was accomplished, indicate number of persons so contacted.

   _____number of persons contacted per man-hour of instructor work (preparation and presentation)

3. Training

_____man-hours of on-the-job performance per man-hour of training

_____number of men participating as trainees compared to number of men assigned to unit.

_____total number of man-hours of training for this unit

4. Planning and administration

_____man-hours total unit expenditure per man-hour of planning

_____average man-hours of planning for each selective enforcement plan or traffic engineering plan formulated

5. Equipment utilization

For each piece of major equipment used in this project note hours of use per total hours of availability

For malfunctioning equipment note the down-time for this quarter.

For equipment used in patrol and selective enforcement indicate number of issued citations associated with each.

Project Suggestions

As noted previously it is evident that Flint is doing a careful and considered job of internal evaluation and subsequent direction of this project. The evaluation suggestions made above are intended to augment the evaluation already occurring and to supply more information to the Office of Highway Safety Planning for guidelines to future projects of this type.

Since the internal evaluation of this program is well in hand, it may be worthwhile to offer a few suggestions pertinent to project

expansion. Police traffic services in a project as large as this can and should encompass more than selective enforcement. Certainly crash investigation is within the responsibility of this unit as it is with most police traffic services projects. Beyond this however, a number of avenues to traffic safety are available for exploration.

One such possibility is the planning of some engineering projects either totally within the police traffic services unit or in connection with whatever office may have that responsibility now. The extensive data available in this project should be brought to bear on highway design and redesign and on the problem of installation and timing of traffic control devices. In addition to the usefulness of the available data bank it is also suspected that patrolmen trained for and completely involved with traffic safety probably develop reasonable traffic control ideas from observations during their regular work. Some means of expressing these ideas such as through a specified "traffic control suggestions" might be useful.

In addition to engineering concerns,the project could undertake some public education responsibilities. The continuation application mentioned increased public contact as a goal so a logical step might be to initiate talks or discussions with civic groups and with school children of all ages. Alternatively, informing the public of the traffic unit's ultimate goals for safer and more efficient highway transportation might be combined with a communication channel for citizens' constructive criticisms and suggestions. Hopefully these approaches might make the citizenry more safety conscious.

A more specific approach to public contact is possible by putting some selective enforcement personnel on a beat in areas of higher pedestrian accident frequency. Police officials often indicate that a very positive aspect of having patrolmen walking a beat is the increased positive public contact. The same effect could be produced by putting men from this project on the street with the special assignment of contacting pedestrians and in noting street crossing violations.

DE 69-1

Community Education Highway Safety Project - Manistique

The Manistique project is unique in that it entails moving a mobile simulator over much of Michigan's upper peninsula. The Alpena project (DE 69-009) also involves a mobile simulator, but its movement is much more compressed in the number of miles it must cover. An immediate question then is how efficient is it to move a simulator over many miles? The project director should be gathering information to indicate hours of moving versus hours of actual use, total students contacted in the present manner versus number of contacts if kept stationary, possibility of transporting students to the simulator rather than vice versa, etc.

The project goals listed in the original application included (1) improved school driver education for 16-18 year olds, (2) adult driver education for beginners and voluntary refreshers, (3) driver improvement clinics, (4) touring of mobile simulator to 13 school districts, (5) first aid instruction, (6) pedestrian safety programs, and (7) public information programs. This is an interesting list, but the quarterly narratives presented to OHSP after initiation of the project give little indication of attempts to evaluate progress toward these goals. It is important that this be done not only from

the standpoint of OHSP but also in Manistique so plans for future simulator use can be made based on the successes and failures of prior use.

It is not the purpose of this review to impose project goals upon any program, but it is our desire to assist in evaluating project progress. Hence, let us look at the general questions which should be asked of each of the original goals:

1. How has addition of the simulator improved driver education for 16-18 year olds? Reasonable measures might be percentage of 16-18 year olds trained since obtaining simulator and percentage trained before. What new things are taught? How many students can an instructor contact with the simulator compared to previously? How many instructors are trained to use the simulator and what was their training?

2. How many adults used the simulator for driver education? How many beginners? How many voluntary refreshers? How many were driver trained before Manistique got the simulator?

3. How many clinics have been held? Who attended? What was taught? By whom?

4. How was the simulator used touring school systems?

   a. How many days on the road?

   b. How many days down time?

   c. How many days of actual instruction? (for each district)

   d. How many students trained? (for each district)

   e. How many student-hours total use this quarter?

   f. What was taught that couldn't be without the simulator?

   g. What training have the driver education instructors had pertinent to simulator use?

   h. How many students were taught per instructor?

   i. What costs have been incurred for simulator repair?

5. How many hours of first aid training have been given? To whom? By whom? In which of the districts?

6. What is included in pedestrian safety training? How many persons have been instructed? By whom? What are the projections for this program?

7. What public information campaigns have been waged and where? Indicate public support for this program.

These, then, are some of the measures that should be taken in order to approach a reasonable evaluation of this project. These are important to OHSP's consideration of similar mobile simulator usage throughout Michigan and it is essential that an evaluation plan of this nature be undertaken by Manistique officials to properly evaluate and guide their project.

EMERGENCY MEDICAL SERVICES

Reductions of mortality and morbidity are the fundamental objectives of emergency medical projects. In addition, nearly all such projects have goals of efficiency of operation and cost reduction. It is desirable then to evaluate projects according to accomplishment of these objectives whenever feasible.

Measurement of reduction in mortality and morbidity is difficult and adequately clear-cut relationships between emergency medical services and these ultimate objectives are not possible at present. Consequently intermediate measures should be incorporated to measure project progress. These can be formulated along the general guidelines of system effectiveness and economic benefits. For example, measures of effectiveness require a description of the system's operation and measures of efficiency and effect of these tasks. Economic benefits include both direct benefits, such as cost reduction, and indirect benefits, such as freeing policemen from emergency medical services so they can spend more time on other duties. This general approach can be applied with appropriate care to individual projects.

The evaluation of a particular project serves two functions. It must (1) provide internal monitoring that will allow efficient and effective management of the project, and (2) include measurements of performance that may be used to internally evaluate achievement of project objectives as well as externally relating the objectives and performance to the State Highway Safety Program. Development of an evaluation program serving either function requires an explicit statement of both project goals and objectives. The evaluation may then be conducted in two phases as outlined below.

1. Management Performance

a. Schedule Objectives

Internal evaluation of schedule objectives should consist of developing a schedule of specific project goals such as acquisition of equipment, personnel training, surveys, data collection, data processing, analysis, etc., and monitoring the adherence to the schedule. Deviations from the schedule should be corrected through reallocation of resources and program modification.

b. Operational Objectives

A primary purpose of program management is to assure successful accomplishment of operational goals. Therefore the operation of the program must be monitored and deficiencies corrected

2. Project Performance

a. Intermediate Measures of Effectiveness

Projects which are implemented to improve emergency medical services may be evaluated in terms of the intermediate measures of effectiveness. Project performance may then be defined by the resulting changes in effectiveness, or by the difference between achieved and desired effectiveness.

b. Economic Measures

The specific evaluation of economic measures (economic benefits) will vary greatly with individual projects, and must be tailored to the local objectives.

The following evaluation checklist incorporates these considerations. It should prove beneficial to both your internal evaluation and planning and to considerations of the state's overall highway safety plan by the Office of Highway Safety Planning.

EM 69-4 IMPROVING AN EXISTING AMBULANCE SERVICE - FRASER

I. Management Performance

A. Schedule Objectives

Has all scheduled implementation been completed? If not, indicate discrepancies between projected schedule and actual schedule.

B. Operational Objectives

1. How many men have been trained in first aid?
2. How many men still require training?
3. Indicate fraction of time ambulance is available for emergency medical service. Do not include down time of vehicle or crew nor time when crew may be serving another function such as firefighting.

II. Project Performance (document following for each run and indicate averages for reporting quarter)

A. Intermediate Measures of Effectiveness

1. Time from receipt of call to dispatch
2. Time and distance from dispatch to arrival at scene
3. Time at scene
4. Time and distance from scene to hospital
5. Time from arrival at hospital to return to service
6. Level of training of each crew individual
7. First aid treatment provided
8. Equipment and supplies used for extrication and treatment
9. Frequency of notification of hospital of arrival
10. Frequency of feedback from hospital on availability of services and consultation or advise on treatment

These measures allow both the computation of frequency counts and correlation between events. It should be noted that while documentation of both transit time and distance have been suggested, they should not be used to compute "velocity" to the scene.

Experience in other programs has indicated that for short ambulance runs, the correlation between time and distance is low. This is likely to be true in Fraser where the distance to the scene is usually less than four miles. The above measurements will allow internal evaluation of attainment of project objectives and are compatible with the objectives of State standards.

B. Economic Measures

1. Time spent on emergency medical runs per month by shift for (a) traffic and (b) non-traffic related incidents (summarize for quarter also).
2. Time spent on fire runs per month by shift (and summarize for quarter).
3. Number of times per month that police back-up services were needed for emergency medical services normally handled by ambulance (summarize for quarter).
4. Estimate man-hours of police time saved by implementation of ambulance. Break this down into (a) traffic and (b) non-traffic cases.
5. What fraction of man-hours of police time saved is devoted to police traffic services?
6. What is your estimated "cost per run" for this project?
7. Can quantitative comparisons be drawn between this project and commercial ambulance services?

APPENDIX II

PROPOSED SUB-ELEMENT CRITERIA MEASURES

This section contains the full set of effectiveness and output criteria measures proposed for the 41 OHSP Program Sub-elements discussed in Section 3.0.

PEDESTRIAN AND PASSENGER EDUCATION ELEMENT

Pedestrian Education Sub-element:

Effectiveness -- Number of pedestrian crashes with pedestrian at fault versus total number of pedestrian crashes.

Output -- (C) Percent of elementary schools giving pedestrian education.

(V) Number of elementary schools giving pedestrian education.

Passenger Education Sub-element:

Effectiveness -- Number of passenger fatalities and injuries versus total number of fatalities and injuries.

Output -- (C) Percent of passengers passing through check lanes who have had driver education, special education or first aid training.

(V) Number of passengers queried times reciprocal of check lane vehicle sample proportion.

DRIVER EDUCATION ELEMENT

Private Passenger Car DE Sub-element:

Effectiveness - - Number of trained drivers involved as private passenger car operators in crashes versus total number of private passenger car crashes.

Output -- (C) Percent of new, passenger car drivers who took a driver education course.

(V) Number of new, passenger car drivers who took a driver education course.

Motorcycle DE Sub-element:

Effectiveness - - Number of trained drivers involved as motorcycle operators in crashes versus total number of motorcycle crashes.

Output - - (C) Percent of new, motorcycle operators who took a driver education course.

(V) Number of new, motorcycle operators who took a driver education course.

Cargo Vehicle DE Sub-element:

Effectiveness - - Number of trained drivers involved as cargo vehicle operators in crashes versus total number of cargo vehicle crashes.

Output - - (C) Percent of new, cargo vehicle drivers who took a driver education course

(V) Number of new, cargo vehicle drivers who took a driver education course.

Bus DE Sub-element:

Effectiveness -- Number of trained drivers involved as bus drivers in crashes versus total number of bus crashes

Output -- (C) Percent of new, bus drivers who took a driver education course.

(V) Number of new, bus drivers who took a driver education course.

Other Vehicle DE Sub-element:

Effectiveness -- Number of trained drivers involved as operators of "other" vehicles in crashes versus total number of "other" vehicle crashes.

Output -- (C) Percent of new, "other" vehicle operators who took a driver education course.

(V) Number of new, "other" vehicle operators who took a driver education course.

DRIVER TESTING AND LICENSING ELEMENT

Private Passenger Car DT&L Sub-element:

Effectiveness -- Number of initial and renewal application rejections for private passenger car driver license versus total number of applications for that class.

Output -- (C) Percent of population eligible who applied for initial or renewal private passenger car license.

(V) Number of applicants for initial or renewal private passenger car license.

Motorcycle DT&L Sub-element:

Effectiveness -- Number of initial and renewal application rejections for motorcycle operator license versus total number of applications for that class.

Output -- (C) Percent of population eligible who applied for initial or renewal motorcycle operator license.

(V) Number of applicants for initial or renewal motorcycle operator license.

Cargo Vehicle DT&L Sub-element:

Effectiveness -- Number of initial and renewal application rejections for cargo vehicle driver license versus total number of applications for that class.

Output -- (C) Percent of population eligible who applied for initial or renewal cargo vehicle driver license.

(V) Number of applicants for initial or renewal cargo vehicle driver license.

Bus DT&L Sub-element:

Effectiveness -- Number of initial and renewal application rejections for bus driver license versus total number of applications for that class.

Output -- (C) Percent of population eligible who applied for initial or renewal bus driver license.

(V) Number of applicants for initial or renewal bus driver license.

Other Vehicle DT&L Sub-element:

Effectiveness -- Number of initial and renewal application rejections for "other" vehicle license versus total number of applications for that class.

Output -- (C) Percent of population eligible who applied for initial or renewal "other" vehicle license.

(V) Number of applicants for initial or renewal "other" vehicle license.

EMERGENCY MEDICAL SERVICE ELEMENT

EMS (Urban) Sub-element:

Effectiveness -- Number of injury victims subsequently listed as fatalities versus total number of injury victims.

Output -- (C) Percent of ambulance runs related to traffic.
(V) Number of " " " " "

EMS (Rural) Sub-element:

Effectiveness -- Number of injury victims subsequently listed as fatalities versus total number of injury victims.

Output -- (C) Average response time of ambulance units (from dispatch to hospital arrival)
(V) Number of ambulance runs related to traffic.

MOTOR VEHICLE INSPECTION AND REGISTRATION ELEMENT

Private Passenger Car I&R Sub-element:

Effectiveness -- Number of private passenger cars with equipment or registration defects versus total number of passenger cars inspected.

Output -- (C) Percent of private passenger cars inspected.
(V) Number " " " " "

Motorcycle I&R Sub-element:

Effectiveness -- Number of motorcycles with equipment or registration defects versus total number of motorcycles inspected.

Output -- (C) Percent of motorcycles inspected.
(V) Number " " "

Cargo Vehicle I&R Sub-element:

Effectiveness -- Number of cargo vehicles with equipment or registration defects versus total number of cargo vehicles inspected.

Output -- (C) Percent of cargo vehicles inspected.
(V) Number " " " "

Bus I&R Sub-element:

Effectiveness -- Number of buses with equipment or registration defects versus total number of buses inspected.

Output -- (C) Percent of buses inspected.
(V) Number " " "

Other Vehicle I&R Sub-element:

Effectiveness -- Number of "other" vehicles with equipment or registration defects versus total number of "other" vehicles inspected.

Output -- (C) Percent of "other" vehicles inspected.
(V) Number " " " "

MOTOR VEHICLE CRASH AND INVESTIGATION SERVICE ELEMENT

MVC&I Service (Urban) Sub-element:

Effectiveness -- Number of crashes involving previous crash debris or blockage versus total number of crashes.

Output -- (C) Percent of tow-away accidents
(V) Number " " "

MVC&I Service (Rural) Sub-element:

Effectiveness -- Number of crashes involving previous crash debris or blockage versus total number of crashes.

Output -- (C) Percent of tow-away accidents
(V) Number " " "

ROADWAY CONSTRUCTION AND INSPECTION STANDARDS AND CERTIFICATION ELEMENT

New Construction Sub-element:

Effectiveness -- Miles of new road under construction conforming to AASHO standards versus total miles of new road.

Output -- (C) Percent of new road mileage surveyed for compliance with standards.

(V) Number of miles of new road surveyed.

Re-construction and Modification Sub-element:

Effectiveness -- Miles of existing roads conforming to AASHO standards versus total miles of existing roads.

Output -- (C) Percent of existing roadway surveyed for compliance with standards.

(V) Number of miles of existing roadway surveyed.

Extra-roadway Accessories Sub-element:

Effectiveness -- Miles of roadway signed and marked in conformance with AASHO standards versus total road miles.

Output -- (C) Percent of roadways surveyed for compliance with signing and marking standards.

(V) Number of miles of roadway surveyed.

ROADWAY REPAIR AND INVESTIGATION SERVICE ELEMENT

Normal Surveillance and Repair Sub-element:

Effectiveness -- Number of crash site repair needs discovered versus total number of crash site repairs.

Output -- (C) Percent of road miles under regular surveillance schedule for identification of needed spot repair.

(V) Number of spot repair or reconstruction recommendations made.

Specific Repair Sub-element:

Effectiveness -- Number of crash site repair needs reported versus total number of crash site repairs.

Output -- (C) Percent of reported crash sites subsequently inspected for repair and reconstruction needs.

(V) Number of crash sites inspected for repair and reconstruction work needed.

CRASH LOCATION DEFECT IDENTIFICATION AND RECONSTRUCTION SERVICE ELEMENT

Crash Location (Urban) Sub-element:

Effectiveness -- Number of crashes at identified repeat crash sites versus total number of crashes.

Output -- (C) Percent of identified repeat crash sites inspected for repairable construction defect.

(V) Number of repeat sites inspected and recommended for improvement.

Crash Location (Rural) Sub-element:

Effectiveness -- Number of crashes at identified repeat crash sites versus total number of crashes.

Output -- (C) Percent of identified repeat crash sites inspected for repairable construction defect.

(V) Number of repeat sites inspected and recommended for improvement.

ENFORCEMENT ELEMENT

Police Traffic Services (Urban) Sub-element:

Effectiveness -- Number of moving violation citations versus number of drivers involved in crashes.

Output -- (C) Number of miles of roadway versus number of traffic patrolmen.

(V) Number of citations for moving violations.

Police Traffic Services (Rural) Sub-element:

Effectiveness -- Number of moving violation citations versus number of drivers involved in crashes.

Output -- (C) Number of miles of roadway versus number of traffic patrolmen.

(V) Number of citations for moving violations.

Alcohol Control Sub-element:

Effectiveness -- Number of alcohol-related violation citations versus number of crashes in which alcohol was involved.

Output -- (C) Percent of police departments with trained operators and alcohol test equipment.

(V) Number of alcohol tests performed.

ADMINISTRATIVE AND JUDICIAL COUNTERMEASURES FOR CRASHES AND MOVING VIOLATIONS ELEMENT

Driver Operation and Condition Violations Sub-element:

Effectiveness -- Number of moving violation conviction repeaters versus total number of moving violation convictions.

Output -- (C) Average delay time from issuance of citation to closing of case.

(V) Number of driver citations processed.

Motor Vehicle Defects Violations Sub-element:

Effectiveness -- Number of vehicle defects repaired versus total number of vehicle defect citations issued.

Output -- (C) Average delay time from issuance of citation to closing of case.

(V) Number of vehicle defect citations processed.

State Codes and Laws Sub-element:

Effectiveness -- Number of Michigan statutes in substantial compliance with Uniform Vehicle Code versus total number of statutes.

Output -- (C) Percent of Michigan Code analyzed for compliance with UVC

(V) Number of statutes analyzed for compliance.

Local Codes and Laws Sub-element:

Effectiveness -- Number of local traffic ordinances in substantial compliance with UVC and Model Traffic Ordinances versus total number of ordinances.

Output -- (C) Percent of local ordinances analyzed for compliance.

(V) Number of ordinances analyzed for compliance.

TRAFFIC RECORDS AND MANAGEMENT INFORMATION ELEMENT

Central Traffic Data Bank Sub-element:

Effectiveness -- Total turn-around time for system inquiries versus total number of system inquiries.

Output -- (C) Percent of individual crash report forms on file in central traffic data bank.

(V) Number of crash reports handled.

Operating Agency Records Sub-element:

Effectivness -- Average response time to information requests.

Output -- (C) Percent of inquiries answered with summary information.

(V) Number of input units.

Management Information System Sub-element:

Effectiveness -- Number of safety system parameter files directly coupled to central management versus total number of safety system parameters.

Output -- (C) Percent of information inquiries answered with requested information.

(V) Number of inquiries so answered.

SYSTEM AND PROGRAM ANALYSIS ELEMENT

R&D Sub-element:

Effectiveness -- Number of fatalities versus total vehicle miles.

Output -- (C) Percent of planned R&D projects active during period.

(V) Number of active R&D projects.

Planning Sub-element:

Effectiveness -- Number of fatalities versus total vehicle miles.

Output -- (C) Percent of SEP's modified during period.

(V) Number of " " " "

Management Sub-element:

Effectiveness -- Number of fatalities versus total vehicle miles.

Output -- (C) Percent of task projects meeting scheduled milestones and objectives.

(V) Number of task projects meeting scheduled milestones and objectives.