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PLANNING FOR CONCENTRATED IMPLEMENTATION OF HIGHWAY SAFETY COUNTERMEASURES

Volume 2: Program Planning Considerations

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16. Abstract

At present there is a recognized need to improve the basis on which resource committments to highway safety activities will be made in future years. The goal of the present study is to formulate detailed plans for experimental programs that will determine the impact of selected safety countermeasures. This report contains a consideration of the factors that we have found to be important in the design of such programs.

From a discussion of the general highway traffic system, six program areas are defined. For each program category, there is a discussion of program goals, applicable countermeasures, measures of effectiveness, and data requirements. Considerations involved in the choice of a suitable site for each program are also stressed.

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PREFACE

This document is the second volume of a four-volume report covering the results of a one-year study contract to determine a program planning methodology for the evaluation of highway safety countermeasures. The present volume contains a discussion of the planning considerations pertinent to this methodology.

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1. INTRODUCTION

In response to the Highway Safety Act of 1966, the National Highway Safety Bureau promulgated a set of program standards designed as guidelines for individual states to plan and implement comprehensive highway safety programs. When the states began implementing these programs, a need arose nationally for some way for allocating available resources to realize the maximum safety benefit. This could be done in a simple manner if each usable change in the traffic system carried a rating that specified its effectiveness. Unfortunately, while qualified safety practitioners can suggest many intuitively excellent ways to reduce accidents, it is difficult to find conclusive evidence of a direct relationship between changes in the traffic system and any of the factors people commonly use to gauge the safety of our highway system. In particular, cost-effectiveness measures relating the total effect of a specified technique to the effort (or cost) needed to produce it are lacking. The difficulty clearly seems to lie in the fact that the highway system is far more complex than is commonly conceived. Consequently, such simple experimental designs as (1) requiring licensing of all mechanics in the state periodic motor vehicle inspection program and (2) measuring the reduction in fatal accidents during the next year do not properly take into account the myriad of other factors that may also significantly affect the accident rate (e.g., the introduction of new cars, an increase in the state liquor tax, a change in the traffic enforcement policy by state or local police, etc.). Claims such as "We introduced driver education and the accident rate went down" are often heard; but there is also a fair measure of doubt about the validity of these claims.

The development of a rating scheme for the Highway Safety Program Standards that is simple to use and credible in the eyes of most decision-makers is certainly desirable. In order to provide this needed ranking of highway system changes (changes we refer to for the moment as <u>countermeasures</u>) the SCOPE (Safety through Concentrated Operational Program Effort) concept has been developed by the National Highway Traffic Safety Administration. The objective of this operation is to provide evaluative support for highway safety demonstration programs in order to develop priorities among the various countermeasure techniques. Such priority ratings could then be used as an aid in determining the allocation of funds to various elements of the traffic safety program at the federal, state, and local level. It is evident that the final decision to commit funds to a safety project is political, since it involves many more factors than those represented by the factual cost-effectiveness ratings; thus, questions of national priority, availability of funding, and other intangible social considerations will always play an important part in such decisions. However, the political decision-maker can only hope to make the proper choice if he begins with complete factual data; the availability of sound rating information on countermeasure priority would supply this needed data base

With this background in mind, the present study sought to define a set of programs that could relate the <u>degree of application</u> of a countermeasure to its <u>utility</u>. In short, how much improvement in performance can be obtained from a given change in the system operation? Measures of success would be chosen so as to be meaningful to decision-makers. As a starting point and basis for this study, a conceptual model of the highway traffic system was developed to investigate cause-effect relationships that exist among component parts. The total system was broken into six relatively distinct categories, each of which has a set of closely related goals and an internal uniformity of countermeasure types and evaluation methodology. These six programs have a nominal relationship to the sixteen existing Standards, as indicated in Table I. Within each of the six program

TABLE I. RELATIONSHIP BETWEEN COUNTERMEASURES PROGRAM CATEGORIES AND THE HIGHWAY SAFETY PROGRAM STANDARDS

Program Title	Applicable Standards
Road User Regulation	Codes and Laws Traffic Courts Alcohol in Relation to Highway Safety Police Traffic Services
Information Flow	Motor Vehicle Registration Identification and Surveillance of Accident Locations Traffic Records
Road User Preparation	Driver Education Driver Licensing Pedestrian Safety
Vehicle Regulation	Periodic Motor Vehicle Inspection Motorcycle Safety
System Restoration	Emergency Medical Services Debris Hazard Control and Cleanup
Highway Regulation	Highway Design, Construction, and Maintenance Traffic Control Devices

categories another cause-effect model was developed tracing the effect of a change in the traffic system toward some ultimate measure of success. Using these models it was possible to identify program goals, select countermeasures that could potentially satisfy these goals, and determine those points in the system at which the evaluation of countermeasure effects could be performed most successfully. Finally, the factors involved in adapting these programs to specific geographic sites were considered in order to arrive at a final program configuration. The resulting plan is intended to test countermeasures that are judged to have some likelihood of success, and to measure their effectiveness. Detailed program plans for experiments in each of the six categories are presented in another volume (3) of this report.

This volume (2) contains a discussion of the design and site selection considerations for the development of the final program plans. Section 2 contains the rationale for six particular program categories and discusses the measurement philosophy common to each. Sections 3 through 8 give more detailed considerations for each of the six programs, while Section 9 contains a discussion of topics pertinent to the choice of an experimental site for this type of program.

2. EVALUATION EXPERIMENT DESIGN

Before proceeding with a discussion of the six program categories listed in Table I, it is important to present a concise summary of the design and measurement philosophy basic to all programs. Beginning with a general conceptual model of the highway safety system, the rationale leading to the development of six particular programs is presented. Consideration is then given to program goals, selection of countermeasures to satisfy these goals, methodology for the evaluation of countermeasure effectiveness, and, finally, requirements for measurement data.

2.1 THE GENERAL HIGHWAY SAFETY SYSTEM MODEL

A diagram showing important aspects of the highway safety system is shown in Figure 1. In the discussion below, letters in parentheses [as (a) for system characteristics or (A) for program designations] refer to labelled boxes in the diagram.

The basic system unit is called an Event (a). This Event may be an accident, violation, arrest, or even an administrative operation such as a title transfer, license examination, or court action. After an event has occurred, two operational sequences result that differ mainly in their response time to the stimulus. These sequences are depicted in Figure 1 as Fast and Slow response operations.

Fast-response operations have immediate consequences: a detection is made (b) and some counteraction response (c) is initiated. A crash, for example, brings the police, emergency medical services, and a tow truck to remove damaged vehicles and other debris. Such activities are considered to jointly form a System Restoration subsystem (A) that encompasses all the fast-response operations. In practice, ambulance services and accident cleanup are the basic tasks of this subsystem.

In addition to its immediate consequences, an event may generate a number of slow-response reactions. For example, if the event is an accident, a policeman or other official may make an accident report and send it to a central information point for storage (d). This report may be a formal one that is subsequently included in some computer record, or it may be an informal comment from the investigating officer to the traffic engineer. Subsequently, some person or agency (e) may analyze that report (together with many others), and make the results available to potential data users: e.g., a department of motor vehicles that maintains a point system for identifying and treating problem drivers; a highway department research section seeking information from accident data to identify highway design problems; or even an insurance company that bases the premium of each individual on his accident experience and the experience of "similar" drivers. Eventually, the analysis output may motivate an action agency that can take appropriate steps to modify the traffic system. Let us consider the steps from initial report generation to the performance of some degree of analysis and final reporting as the defining operations of an Information Flow subsystem (B).

The analyzed data output of the Information Flow subsystem is the input to a group of Action activities (f). Any actions that result from this formal or informal information input will reflect the nature of the traffic system component they seek to correct--the road user, the vehicle, or the highway--and will produce a change (or at least an attempt at change) in the characteristics of this component (g), (h), or (i). The changes that are produced should subsequently alter the operating performance (j) of the affected part; hopefully, this will in turn cause a reduction of the system's

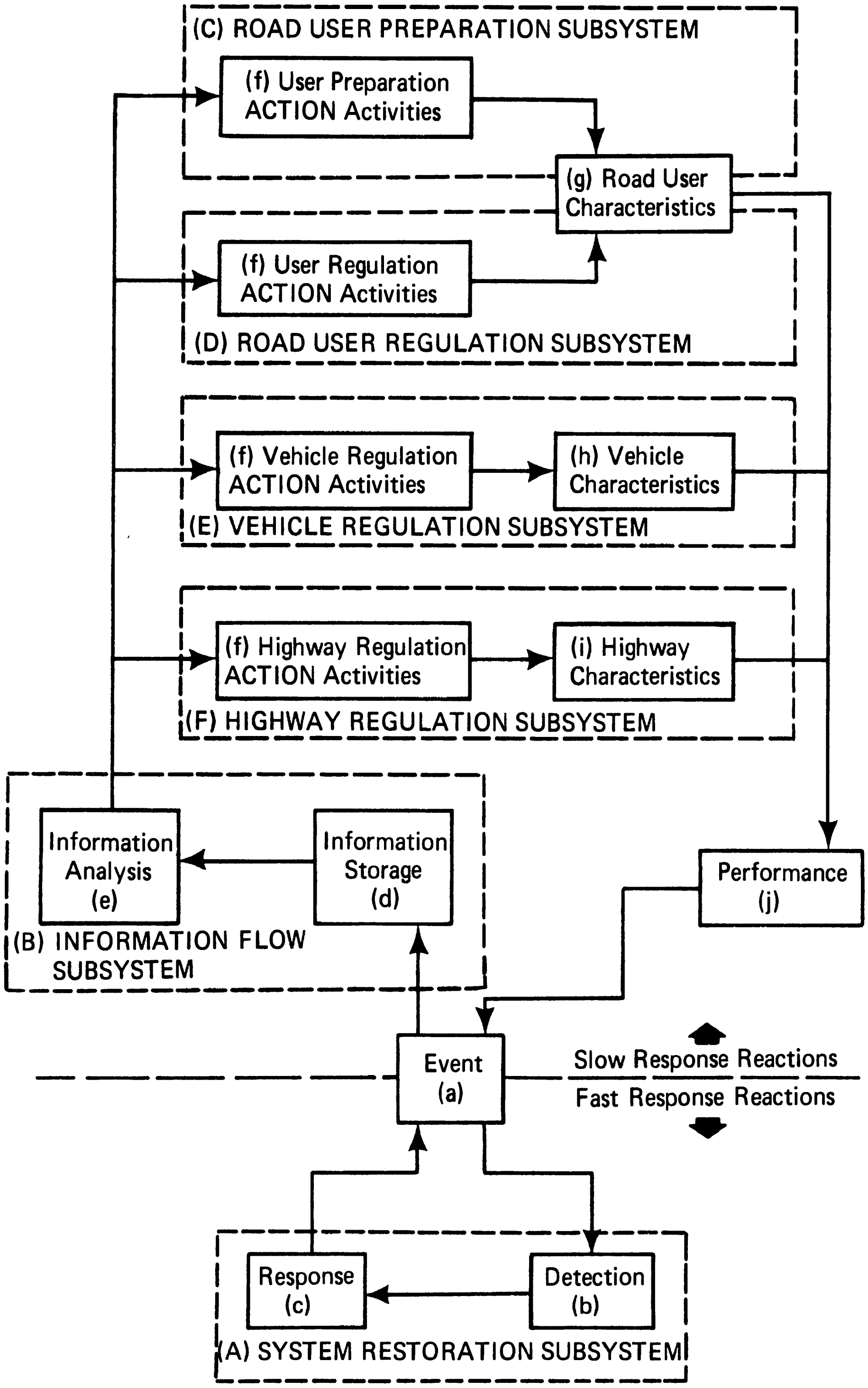


FIGURE 1. A CONCEPTUAL MODEL OF THE HIGHWAY SYSTEM

accident production potential (i.e., a reduction in the probability of an untoward event). Action activities in summary, then, are operations that utilize analyzed event reports as input and that act on road users, vehicles, or highways to modify their characteristics. Conceding that people represent the most complex part of the system, we have identified four action-oriented subsystems: (1) Road User Preparation (C), (2) Road User Regulation (D), (3) Vehicle Regulation (E), and (4) Highway Regulation (F).

Partitioning the general traffic safety system in this fashion yields six subsystems that have consistent internal goals and minimal functional overlap. The courses of action recommended by several similar Highway Safety Program Standards are associated with a single subsystem. For example, Road User Preparation involves most elements of the Driver Education and Driver Licensing Standards.

Division of the general traffic system into a minimally interacting set of subsystems does not in itself prove that these submodels should (or could) form the basis for a set of implementable measurement programs. However, just as the subsystems display a unity of goals and methods as a result of the way they are defined, the countermeasures applicable to each imply a corresponding uniformity of measurement techniques for their proper evaluation. In a Road User regulation program we might evaluate the direct effect of a given countermeasure by employing a subjective measure of driver reaction such as an opinion survey. In contrast, a vehicle regulation program would commonly employ objective measures to quantitatively evaluate mechanical parameters. The conclusion, therefore, is that six experimental program categories should be defined where each category corresponds to a highway safety subsystem area described above. This will permit a rather complete demonstration of the possible countermeasures and evaluation techniques that are applicable. The use of program "category" is emphasized here because the need for control groups and multiple site studies will certainly result in more than six actual programs.

Each of the proposed program categories defines an experimental effort that should permit us to determine the relative value of different techniques for achieving safety on the highway. But even in proposing such experiments, it is necessary to prejudge the outcome and order the programs in terms of their benefit to society. At the present time, it seems unlikely that all six of the programs will be funded in the near future, so that some decision is necessary as to which effort should be undertaken first. In making this judgment, several important factors need to be taken into account:

(1) Where is the money likely to be spent? Which area does the funding source (e.g., Congress) feel is the most important?
(2) In what area is the analysis of data most likely to produce a successful outcome?
(3) Which areas already have sufficient activity and are not in need of further effort at the present time?

If resources were unlimited, all six programs should be implemented in parallel to produce the most comparable data. Since this is seldom the case, the consensus seems to be that the programs should be conducted in the following order:

(1) Road User Regulation
(2) Information Flow
(3) Road User Preparation
(4) Vehicle Regulation
(5) System Restoration
(6) Highway Regulation

2.2 PROGRAM GOALS AND SITE SELECTION

Within each program category a set of needs and requirements can be defined in response to unsafe conditions that exist; thus, excessive speeding on a certain section of highway suggests the need for speed control, perhaps through better enforcement. These needs and requirements, together with more broadly defined objectives imposed by society, constitute the goals of the highway safety program.

The primary goal is to reduce accidents, fatalities, property damage, and other events that adversely affect people's lives in a direct, immediate fashion, and, at the same time, maintain an efficient flow of traffic. There is nothing remote or complex about having a member of one's family killed; the event and its consequences are immediate and strongly affect the persons involved. Goals such as accident or fatality reduction are referred to herein as ultimate goals because they represent a long-term objective of the safety system to meet an immediate need.

On the other hand, there are a large number of less significant, but more readily implemented goals that do not have the evident value of the ultimate goals. The reduction of speeding violations in the example discussed above might be such a goal. The accomplishment of this goal might not reduce accidents in a measureable fashion (i.e., the reduction might not be statistically significant) until long after the fact, perhaps several years. But a reduction in the percentage of speeding cars would represent a measureable improvement in the traffic safety system. Goals of this nature are referred to as immediate goals.

The ultimate safety goals (accident, injury, or fatality reduction) have achieved universal acceptance and are consequently not peculiar to any geographic locality. No matter what site is chosen for a demonstration program, it is reasonably certain that the ultimate goals of the effort will be the same; this means that the measurement of effectiveness in terms of ultimate goals leads to a nationally applicable set of results--a desired goal. In those programs that change some component of the traffic system closely associated with the accident process, it is often possible and sometimes easy to measure effectiveness in this way. Thus, the use of helmets by motorcycle riders should be reflected in the injury and fatality statistics of relatively small samples.

In a safety effort characterized by some rather indirect component change, however, the ultimate goals are an insensitive measure of effectiveness. Examples of changes of this type include a new simulator for driver education or a new speed detection device for the police. One must often be satisfied with the suggested partial realization of ultimate goals through the measured realization of intermediate goals. As emphasis is shifted from ultimate to intermediate goals, the spectre of national applicability rises to haunt the planner. Again, returning to the example of speeders, the occurrence of speed violators on a particular section of highway is a local problem--worse yet, its solution is also likely to be locally applicable. The particular site used for the demonstration experiment may, therefore, determine the applicability of the results obtained. Thus, if intermediate goals are considered to be acceptable system goals (a view we strongly support), there is a definite connection between goals and the site selection process.

There is a need then for some procedure for choosing a suitable site. At a minimum, the selection process should take into account the following factors:

(1) There should be a significant problem to be solved.
(2) The problem should have nationally applicable significance.
(3) The jurisdiction should be large enough to insure that statistically meaningful results will be obtained from the program.
(4) The local jurisdiction must have the capability to carry out the program; this consideration applies to the equipment, manpower, and resources aspects of the program, but more importantly to the managerial ability of the local government to administer both the operational and experimental tasks necessary for successful completion of the program.

The site selection process is considered to be an important phase of the overall program planning effort and is discussed in more detail in Section 9 of this volume. We note here, however, that site choice is critical for the SCOPE programs since the results obtained will hopefully have universal application: that is, they should be capable of being validly extrapolated to other jurisdictions.

The problem of determining needs or goals has been approached through recourse to comprehensive sources of information. In particular, data were gathered from four main sources:

(1) The Highway Safety Program Standards
(2) A review of the technical literature
(3) A study of "402" and "403" programs
(4) Discussions with NHTSA Regional Administrators and other knowledgeable parties

From these sources, the established needs of the safety community may be determined. On the basis of this information a number of tentative sites have been selected for experimental design. These selections are not intended to represent unique or even final choices--indeed, it is suggested that the final choice be made through the evaluation of proposals.

2.3 COUNTERMEASURE CANDIDATES AND THEIR SELECTION

In Section 1, a countermeasure was tentatively defined as a change in the traffic safety system. It is useful to expand this definition somewhat before presenting the procedure for selecting those candidate efforts for the experimental program.

Although the definition of a countermeasure given above is general enough in most respects, it does not suggest any criteria for selection. Using the terminology developed in Section 2.2, therefore, the following definition is advanced:

> A countermeasure is a highway safety system change introduced in response to a <u>recognized</u> ultimate <u>or</u> intermediate goal.

Use of the word "change" may be somewhat confusing since an established police function is not a countermeasure by this definition. However, for purposes of our discussion, this alternative is preferable to considering the entire safety system as a countermeasure.

A logical program planning methodology calls for the determination of countermeasures within each of the six program categories that hope responsively to satisfy the goals defined in Section 2.2. The selection of appropriate measures should be guided by the following principles:

(1) Identify areas of activity where the practical implementation of techniques and knowledge lags far behind the state-

of-the-art. (For example, are new highways being built with the best available anti-skid materials?)

(2) Once these areas have been identified, specify the appropriate changes (by type and level of application) taking into account the detailed characteristics of the particular site.

The state of the art in each category, as well as the type of changes found most useful in the past, were determined from the information sources discussed in Section 2.2. The literature review resulted in the compilation of a bibliography that constitutes a sizeable information base covering the state of the art in highway safety countermeasures. The bibliography is contained in Volume 4 of this report. In addition, a complete listing of "402" and "403" projects through July 30, 1970 was obtained from the National Highway Safety Bureau. A computerized file containing 29 descriptive factors on 4254 projects facilitated a study of the diverse efforts expended in these programs. Appendix A contains a description of the computer file and presents a sampling of results that were derived through its use.

2.4 COUNTERMEASURE EVALUATION METHODOLOGY

Having defined the program categories and sources of information, the central problem of rating countermeasure effectiveness by measuring their success in reducing or eliminating undesirable aspects of the highway system (i.e., accidents, fatalities) must be considered.

The selected approach to this difficult task was to begin by designing each program to determine countermeasure Utility as a function of Degree of Application (i.e., what do we gain per unit effort expended?). To illustrate, suppose we study a water purification method by measuring the number of bacteria killed per unit volume of water (Utility) for a number of different volumetric concentrations of chlorine (Degree of Application). Properly done, this study provides the information on critical features of the relationship between bacteria and chlorine, as indicated in Figure 2, which is: applying small quantities of chlorine does not create a lethal dosage and produces negligible effect (low utility). Increasing dosage to the point where some effect is noticed identifies a critical minimum degree of application. The dosage may be progressively increased until a critical maximum degree of application is reached. Beyond this point, saturation takes place and further increases in dosage do not increase the utility. Knowing the two critical dosages, we can define the useful operating region for this purification technique. The basic concept used here is the cost-effectiveness approach to evaluation: the utility, or number of bacteria killed, measures the effectiveness of the technique while cost is related to degree of application.

Unfortunately, a one-dimensional relationship between quantifiable measures (as shown in Figure 2) does not apply to the highway safety problem. In the evaluation of countermeasures, both utility and degree of application are multidimensional quantities involving diverse components. The utility of a police patrol depends, among other things, on the reduction in accidents that it produces (a measurable, numerical quantity) and reaction of the drivers toward the regulation policy (a difficult-to-define, categorical quantity). In the same situation, degree of application would be measured by the number of police assigned to the patrol (numerical)

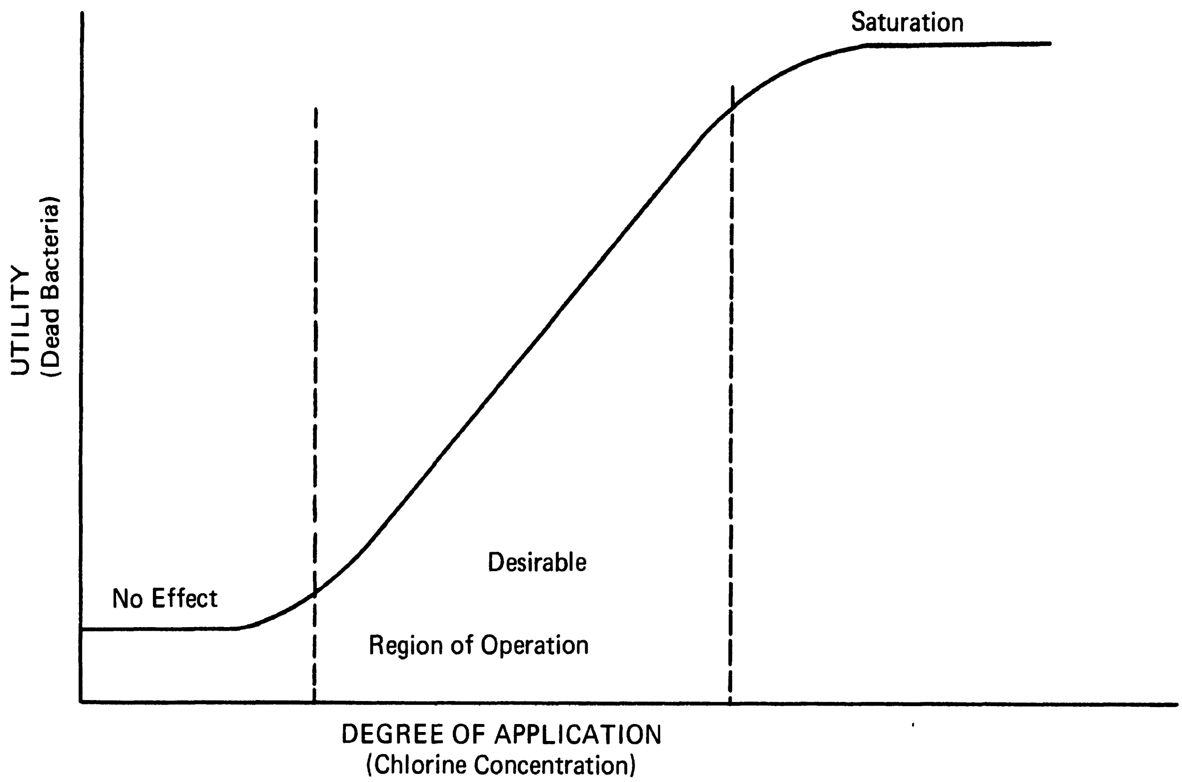


FIGURE 2. TYPICAL UTILITY-APPLICATION FUNCTIONAL DEPENDENCE

and the attitude of each policeman in enforcing the law (categorical). In selecting dimensions of the utility and degree of application variables, the aim is an inclusion of all significant factors that affect the countermeasure application as well as all factors affected by the countermeasure. In this way, variations caused by uncontrolled or unmeasured factors are kept as small as possible. In a practical situation, it will obviously be impossible to fulfill this requirement since many important features are not understood well enough to lead to their proper treatment while other factors simply cannot be measured because of social or physical constraints. Where full data are not available, it is possible to interpret those elements of the experiment over which we have no control. Modern analysis techniques are available to deal effectively with this contingency. In particular, the method of "quasi-experimental design" offers a means of treating this type of commonly occurring situation (Ref. 1).

Aspects of this measurement scheme are known more widely in scientific jargon as intermediate criteria or proxy measures: that is, if we refer to accident or fatality reduction and other long-term, high-priority components of the utility measure as ultimate criteria, then the less serious, short-term effects and surrogate information discussed above (as driver reaction to enforcement) are the intermediate criteria. The notion of intermediate criteria is important to countermeasure evaluation, and deserves further expansion. A better idea of the concept can be gained through the use of examples. A number of intermediate measure categories are presented below, together with examples of each.

(1) Indirect Indications of Results:
  - Fewer complaints
  - Favorable press reaction
  - Favorable public reaction
  - Public opinion survey results
  - Conflict measurements
  - Acceleration noise measurement

(2) Time To Get to a Place:
  - Fire department } transit times
  - Ambulance } transit times
  - Police cruiser } transit times

(3) Time To Do Something:
  - Clean up debris
  - Fix a sign
  - Extract injured persons from a wreck

(4) Quantity of Things Done:
  - Items of information distributed
  - Number of vehicles inspected
  - People surveyed
  - People trained

(5) Cost Reductions
  - Ambulance runs
  - Vehicle maintenance
  - Use of new sign materials

(6) Quality of Subproducts
  - Reduction of vehicle rejections at inspection
  - Reduction of drivers failing the license examination

Because of inadequate sample sizes (discussed in Section 2.5) and random variations caused by unknown factors that enter any practical experiment, a statistically significant drop in accidents often cannot be achieved for some countermeasure programs. The use of intermediate utility measures, however, permits the evaluation of statistically significant results even when the ultimate effects are indeterminate.

The discussion up to now has only addressed the single countermeasure evaluation problem. Many such techniques must often be studied simultaneously in a single program to provide a cost-effective, realistic experiment. In setting up a plan to accomplish this goal, our first step was to define a small number of similar countermeasures as a Group. The notion of a Group arose from a review of the literature, in which it is evident that countermeasures may be broadly classified according to the function that they perform. A Group is consequently defined as a set of countermeasures that have similar functions and that commonly occur in combination with one another.

While this definition leaves something to be desired in the way of scientific precision, the wide diversity of techniques and philosophies found in the six program categories makes a more exact definition impossible. For purposes of the discussions in this report, an example might best serve to illustrate the concept. For a more concrete realization of a group the reader is referred to the detailed program plans in Volume 3 of this report. Consider, then, the ambulance system. A review of past work in this field indicates that the efforts may be classified into the following countermeasure Groups: Training, Equipment, and Planning and Communication. These form the basic building blocks for this program. In the training group, the applicable countermeasures include:

(1) The NHTSA attendant training course
(2) A refresher course for in-service training of current attendants
(3) An advanced training course for the dissemination of advanced skills

Note that the countermeasures all deal with training, but that individual countermeasures in the group may attack quite different aspects of the problem. For evaluation purposes, it is important to note that the effects of countermeasure groups must be measured--not the individual countermeasures themselves.

In a given evaluation program, a number of different groups are measured simultaneously. In order to completely define the effect of a given group, therefore, it is necessary to measure not only the effect of the Group itself in the absence of all others, but also the effect with all combinations of other Groups. Suppose, for example, that we have three countermeasure Groups (designated simply as A, B, and C) for evaluation. Seven programs are then required to determine the effect of the possible combinations defined by;

(1) A,B,C (one-way interactions)
(2) AB,AC,BC (two-way interactions)
(3) ABC (three-way interactions)

With two groupings, only three efforts are necessary to define all the possible interactions (A,B,AB); as the number of groupings increases, however, the number of interactions increases rapidly. For N groupings, the total number of evaluations required to define all possible interactions is expressed by the mathematical formula:

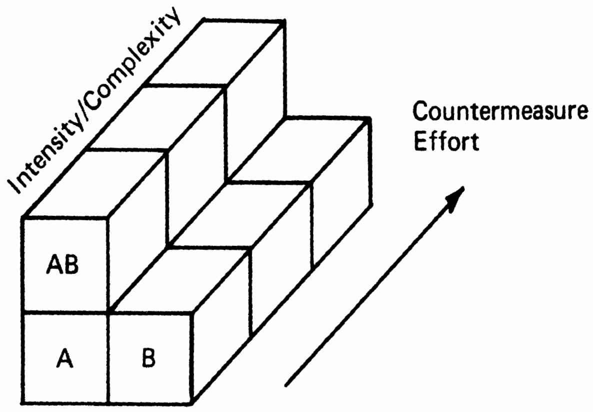
$$\text{Number of Interactions} = \sum_{k=1}^{N} \frac{N!}{k! \cdot (N - k)!}$$

where, for any number n, n! = n * (n - 1) * (n - 2) * ... * 1.

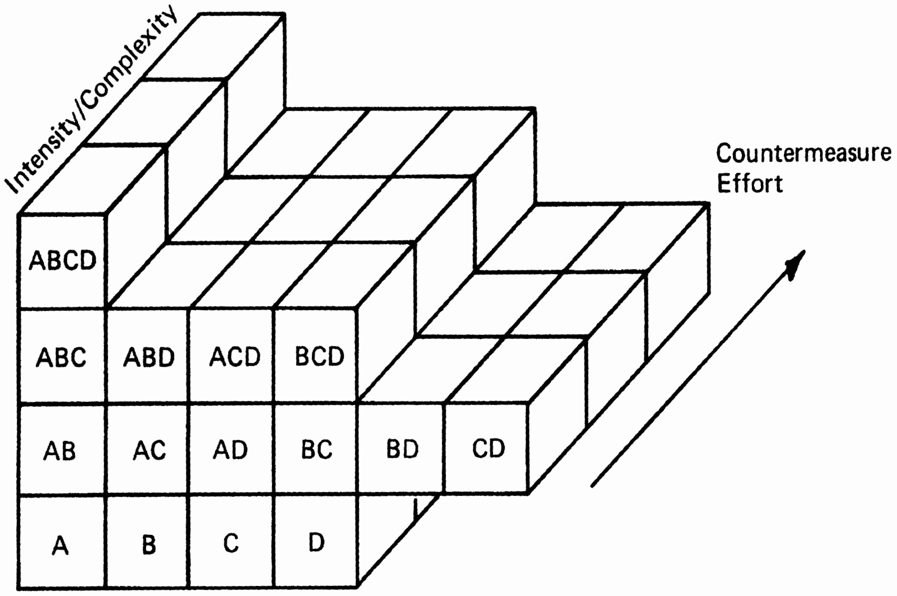
In practice, the total number of possible interactions is much too large to evaluate in a reasonably sized program effort. (For ten groupings there are 1023 interactions). However, many interactions can be eliminated by a before-the-fact study of the problem. For example, if one countermeasure grouping concerns the purchase of an ambulance for emergency medical services while a second involves the recruitment and training of its crew, then it is useless to consider the isolated effects of each. Only the combination (or two-way interaction) is important.

The final dimension of the program plan is the amount of countermeasure effort (referred to earlier as degree of application); that is, each of the above-defined possible interactions chosen as significant must be evaluated at a number of different intensity levels to define the cost-utility relationship. Although the decision is arbitrary, a balance of scientific and economic considerations indicates that three separate degrees of implementation are adequate (such as good, better, best; or mild, moderate, severe).

A final view of the suggested data matrix for experimental design is shown in Figure 3 for the cases where two and four countermeasure groupings are utilized. It should be emphasized that this plan is not suggested as an appropriate scheme for a single experiment, but is intended as a longer-term approach to the problem of adequately defining the complex factors that arise in the highway safety system.



(a) Two countermeasure groupings



(b) Four countermeasure groupings

FIGURE 3. SAMPLE DATA MATRIX FOR EVALUATION PROGRAMS

Carefully performed, the measurements described above will relate utility to degree of application. As discussed earlier, this is a cost effectiveness model--the gains effected by the technique under evaluation are measured as a function of their cost. The final question is how to compare utility measures in order to assign a priority rating to the full range of countermeasures. For example, is a pre-driver seat belt indoctrination program that produced a 30% information retention factor after six months "better" than a vehicle inspection program that forced a 20% reduction in the number of defective brakes? Full cost-benefit comparisons--dollars saved in accident and injury reduction for dollars spent in change programs--are conceivable in those programs which are very close to the accident process. A highway department can consider in its budget whether to spend money next year on installing new "wrong way" signs at freeway exits or a new center guard rail on freeway sections with less than a 20-foot median. Even this is not an easy decision, and may involve many disputes before it is made.

But comparisons between fields of marginal changes, such as driver education and vehicle inspection, involve both less direct evidence of success and competing political forces. Decisions to allocate funds to such programs are ultimately made in the political arena by city councils and state legislatures. Thus they are based on a myriad of information available to these bodies. Scientific cost-benefit analyses, even if they were correct, are likely to become no more than food for controversy in the decision-making process. Cost-effectiveness, on the other hand, as we have discussed it here, seems more useful. The decision-maker can take evidence of the success of a change in relatively hard terms (the police department's new radar program has cut speeding on main street in half) and use his mental capabilities to judge the relative budget requests of the police department and some competing agency. However, one should not stop trying to get at the relative evaluation process in a cost-benefit sense. Statistically, better evaluation methodology will lead more decision-makers to accept the results, and hopefully to make better decisions.

2.5 DATA REQUIREMENTS

Most quantities to be measured are characterized by "natural" or "chance" variations in addition to those that have been induced by the treatment program itself. Thus, accident rates vary from month to month even in a controlled environment. To separate changes due to unexplained causes from those caused by the countermeasure, we must sample to define the range of natural variation, thereby permitting a determination of whether any future change is likely to be the result of chance. It is usually necessary, then, to specify that the evaluation experiments be conducted in locales with a certain minimum population in order to insure an adequate look at the processes that are taking place.

As a result of the heavy utilization of intermediate criteria in program evaluation, activities such as surveys and special observations of driver behavior, court actions, etc., are important sources of data to supplement normal accident data.

Accident data alone are deficient for the evaluation of the majority of highway safety countermeasures in several respects:

(1) They are slow to respond to changes in the system. Several years may be required to observe an effect.

(2) They do not show why the observed change occurred or what part of the program was responsible for the change (i.e., they do not reflect the complex, detailed factors necessary to evaluate the manifold countermeasure effects that occur). Knowing the why of countermeasure effect is an important factor in extrapolating results of the demonstration to other locales with differing requirements and conditions.

(3) By themselves they lack exposure data to compare the accident statistics to similar statistics for the motoring population at large.

Total accident statistics (number of accidents, injuries, fatalities, etc.) adjusted by exposure data will continue to be an important ultimate measure of the efficacy of programs introduced to minimize traffic accidents, and, as such, cannot be disregarded. But in most cases discussed in this report, some measure of value must be obtained soon than the accident data will allow.

2.6 SUMMARY

In this section a consistent procedural approach to the planning of countermeasure demonstration programs has been outlined. Basically the steps in this approach are:

(1) Define broad program categories
(2) Determine program goals in each category that are achievable or likely to be achievable
(3) Choose experimental sites where the goals are in evidence
(4) Select countermeasures to meet the program goals
(5) Choose utility measures to evaluate countermeasure performance as a function of degree of application
(6) Utilize the cost utility measure developed above in the political decision-making process to weigh the available alternatives

3. ROAD USER REGULATION

The Road User Regulation program category is concerned with the actions of those agencies which concern themselves with the performance of regulation of people who use the highway system. It is, consequently, the largest, most complicated, and probably most important of the six categories. The Highway Safety Standards and the specific objectives of each standard applicable to the driver regulation field are shown in Table II.

TABLE II. HIGHWAY SAFETY STANDARDS RELATIVE TO DRIVER REGULATION

Standard	Recommended Activities
Codes and Laws	Achieve statewide uniformity of rules of the road Compare laws with those of other states
Alcohol in Relation to Highway Safety	Establish chemical and legal procedures for blood alcohol determination Enact implied consent laws Perform alcohol tests in fatal accidents Establish procedures for tests, reports, and technician qualification
Traffic Courts	Report all moving violations to the state record system Individuals charged with hazardous moving violations must appear in court Courts must be financially independent of any fee system Court services must be available to offenders Establish a uniform accounting system Establish uniform court procedures Provide current manuals and guides
Police Traffic Services	Establish uniform training procedures Utilize selective personnel assignment techniques Develop investigation, reporting, and recording procedures for accidents Develop procedures for recognizing and handling hazardous conditions Establish agreements between the state and its subdivisions regarding responsibility for traffic services

Conceptually, there are three components of the regulation process that can be discussed individually:

1. The Regulations
   (Codes and Laws and their interpreters, the Courts)
2. The Regulators
   (Enforcement actions carried out by the Police)

3. The Regulated
(Behavioral characteristics of drivers)

In the view of modern legal theory, traffic laws, rules and regulations pertaining to the operation of motor vehicles are intended to establish a behavior pattern that leads to the safe and efficient use of the highway system. The codes and laws are consequently intended to be preventative in nature. The court system is the interpreter of the law and as such is responsible for administering justice so that the spirit of the law is preserved as conditions change. In recent years, there has been considerable controversy about the court's success in achieving this task in view of large case loads and the increasing administrative burdens of the system.

The prime responsibility of the police department in providing traffic services is to insure that the codes and laws established for user behavior are adhered to and that those persons deviating from the established norms of safety and legality are apprehended.

The traffic services of the police force can be logically broken down into three categories:

1. Street Functions: Traffic control, enforcement, accident management, motorist services, etc.
2. Support Functions: Court appearances, education activities, accident analysis, etc.
3. Management Functions: Financial control, manpower deployment, plant maintenance, staff training, etc.

Although this program category should properly include all the social and psychological aspects of the highway environment, the problem of alcohol intoxication is currently receiving major attention through the Alcohol Safety Action Program (ASAP). Consequently, this area has been dealt with only to the extent that it interfaces with other road user regulation actions.

3.1 PROGRAM GOALS

A major objective of the entire road user regulation effort is to cause users of the highway system to abide by the established set of laws. If these laws do indeed promote accident prevention as they are designed to do, then satisfaction of the ultimate goals of accident and fatality reduction will be achieved.

In the field of Regulations, the recognized goals are the promotion of uniformity of the set of codes and laws, and a general streamlining of the court system to achieve an optimized usage of the facilities and manpower available. Congestion of the traffic courts has received considerable attention in recent years and is considered to be a major failing of the court system.

A major goal in this field is to generate a more efficient use of existing regulatory facilities and manpower through the practice of modern management techniques. This can take the form of direct administrative modifications, better use of training programs for new and experienced personnel, and the efficient use of manpower through advanced selective enforcement techniques. The use of selective enforcement is currently receiving strong support from the NHTSA Selective Traffic Enforcement Program (STEP) effort.

3.2 COUNTERMEASURE PROGRAMS

From our study of the countermeasure programs that have been carried on in the past, we were able to identify nine different kinds of activities that have been included in the road user regulation category. They are:

(1) Measurement efforts where an ongoing Police Traffic Services (PTS) program is simply measured (usually only at a minimal level) for performance and effectiveness measures.
(2) Management improvements are overlaid on an ongoing PTS program where techniques such as manpower allocation and cost-benefit methods are implemented.
(3) Training programs where present PTS manpower is trained for some selected advanced skills (behavioral science, management, etc.) or in the use of specific tools (e.g., radar, etc.).
(4) Manpower additions where more manpower, either at or above the current training level, is added to a PTS force.
(5) Equipment additions where major investments in electronic enforcement gear are made along with some minimal training effort and implementation scheme.
(6) Procedural clarifications in codes and laws where streamlining, standardizing, and training occur, dealing mainly with the optimized usage and administration of old laws as well as the implementation of new laws.
(7) Logistical improvements in the handling of court-related problems where procedures and communications between PTS units and courts are made more efficient.
(8) Media efforts where increased communication between the public and the police agencies are attempted.
(9) Social-Individual problem handling techniques are implemented where a system of direct contact actions is used to influence problem drivers (e.g., alcoholics).

This list of activities has been ordered so that in going from activity (1) to activity (9) we progress from programs that have little to do with actual user contact to those that are heavily involved with user behavior. The scale is consequently one of contact between the road user and the enforcement system.

3.3 COUNTERMEASURE EVALUATION

In the road user regulation programs it is our conclusion that behavior should be a major measurement concern. Rather than using only the standard behavioral measures (number of arrests, accidents, etc.) a more uniform and extensive approach to user behavior is suggested. In the language of Section 2, we are again emphasizing the need for intermediate criteria where, for this program, these criteria are most appropriately chosen from a set of factors that describe those aspects of personal behavior that affect the highway system in general and driver behavior in particular.

Hopefully, any regulation program will alter both behavior and the decision-making processes of drivers. In fact, if we can accept the psychologists' three-dimensional model of attitude, and if we are to change attitudes toward driving, then we must consider the (1) cognitive or decision-making components, (2) affective or emotional components, and (3) connative or behavioral-tendency components of an attitude. As an example of how these three components can act independently, people may believe (cognitive) that speeding is dangerous, may fear (affective) the negative outcomes, and yet will tend to go ahead and speed (connative). Thus we feel that in order to obtain a meaningful indication of the processes taking place in an enforcement action, all three components of the reaction must be measured in some fashion.

In the road user regulation program category, the number of encounters between the user and the enforcement agency is large and leads consequently to a large number of entry points for countermeasure evaluation. In Table III some of the possible police activities are presented together with the person or device that might be used to monitor the activity and a typical intermediate criteria for measurement of utility. This list is only an example to illustrate the type of system characteristic that could be measured; specific applications of the utility measure will be found in our detailed program plans in Volume 3.

TABLE III. PTS ACTIVITY-AGENT-CRITERION CHART

ACTIVITY	MONITOR	CRITERIA
Support Services:		
Safety Education	Observers	Amount, Effectiveness, Cost
Traffic Engineering	Observers	Congestion, Accident rate
Public Information	Observers	Amount, Effectiveness, Cost
Court Services	Observers	Number of Appearances; Testimony Quality, Amount, Preparation
Data Management	Observers	Amount, Reliability, Accuracy, Depth
Training	Observers	Amount, Effectiveness, Cost, Quality
Management	Observers	Satisfaction, Effectiveness/Time Unit
Street Services:		
Motorist Services	Police	Number of Incidents, Waiting Time
Detection & Arrest	Police	Enforcements/Violation, Observed Equipment Violations
Accident Management	Police	Segmented Waiting Time, Number of Accidents
Traffic Control	Police	Congestion; Hazards removed
Dangerous Acts:		
	Loop Detectors Observers	Speed Tailgating Near Misses
	Police Observation	Warning, Citation, Arrest, Conviction
Accident:		
	Police Observation	Rate, Fatalities, Injuries, Collisions, Cost, Social Loss, Accident Type

4. INFORMATION FLOW

The Information Flow Program category deals with those aspects of the highway safety system that involve the collection, preparation, storage, retrieval, analysis, dissemination, and utilization of traffic safety data. These data include driver, vehicle, highway, and accident records. Information Flow systems are an integral part of many Highway Safety Program Standards. Table IV shows the standards directly applicable to the Information Flow category together with a summary of the actions recommended in each.

TABLE IV. HIGHWAY SAFETY STANDARDS AND RECOMMENDED ACTIVITIES FOR THE INFORMATION FLOW PROGRAM CATEGORY

Standard	Recommended Activities
Motor Vehicle Registration	Each state shall have a motor vehicle registration program which shall provide for rapid identification of each vehicle and its owner. Pertinent information should be made available for accident research and program development.
Identification and Surveillance of Accident Locations	Each state shall have procedures for the accurate identification of accident locations on all roads and streets. There should be a program for the continuing surveillance and correction of high-accident locations.
Traffic Records	Each state shall maintain a traffic records system that includes data on drivers, vehicles, highways, and accidents. Methods for compiling and analysing the data should be developed. All records must be open to the public in a manner that does not identify individuals.

In the causal chain model of the highway safety system presented in Figure 1, the information subsystem provides the essential link between the event and the resulting regulation program for slow-response reactions. Consequently, information-flow activities provide the feedback loop that furnishes data to affect the highway practitioner's decision-making ability. It is important that the information system gather all the usable data and distribute it to the agencies that can make the most use of it.

With the advent of modern computers and sophisticated data-processing equipment, the collection and storage phases of the information task have received a new impetus; correspondingly, these program phases have received a great deal of attention in recent years. New equipment has permitted the inclusion of large amounts of data on our expanding motor vehicle population while at the same time providing a capability of data retrieval in short periods of time. Thus, video computer terminals are now located in some courts so that a trial judge can examine the past violation record of a driver before passing sentence (Ref. 2).

Collection and storage of data are not sufficient, however. In order to complete the feedback loop necessary for countermeasure action to take place, it is necessary to process the stored data and to make it available to those people who can benefit by it. This aspect of the information system has not, in our opinion, received sufficient emphasis. Processing can take many forms with many degrees of complexity. At a basic level, the information can be categorized and summarized to reach a general audience and to provide local jurisdictions with the latest happenings in the overall safety picture. A more sophisticated analysis task might consist of the statistical analysis of the raw input data to determine changing accident trends, and to forecast expected accident patterns. In any case, the responsibility of the information system is to put the available data into the hands of the people or agencies who can utilize it in a form that is most meaningful to these users.

Although we have discussed the Information Flow program category as a distinct entity, it should be realized that data recording and utilization activities are important to all the program categories. This fact is again simply a restatement of the causal chain relationship discussed in Section 2.

4.1 PROGRAM GOALS

As discussed above, the prime emphasis of most Information Flow activities has been the development of suitable techniques to handle the huge amounts of data available today. Consequently, many state governments have complex operational systems to gather and store data, but have spent little effort to date in stimulating wide usage of the information that has been gathered. A primary intermediate goal of the Information Flow Program, therefore, is to promote maximum utilization of the existing records by all highway safety practitioners.

The participation of local government agencies in the Information Flow system is an important part of the data utilization problem. Local participation provides an opportunity for the state and local governments to pool their experience and data to their mutual advantage, and opens the possibility of local use of electronic data processing equipment for statistical analysis. The importance of local government participation is noted in Chapter VII of the Traffic Records Program Manual (Ref. 3). In essence, we need to use the available data to solve real existing problems (which occur at the local level). Thus, the compilation of spot maps and location files on the local level stimulates more interest than it would if the data were "spoon-fed" from the central agency. In fact, local law enforcement agencies will quickly discover any weaknesses or missing data in their system when they are required both to generate the data and to implement decisions based on it. One of the broadest countermeasure programs at the county level is being conducted in Oakland County, Michigan. The testimony of Bruce Madsen before the Senate Committee on Public Works noted the value of local data utilization:

A substantial increase in traffic accidents and fatalities--such as that which we experience--has many times, in many places, resulted in an aroused, concerned public. All too often, hastily established organizations have emerged to deal with the problem. As a result, the programs and solutions are frequently based upon little or no knowledge of the real problems and needs.

We wanted to make certain that we wouldn't make the same mistake that some other counties made in dealing with this problem, so we set out, in what has been described by traffic authorities as a unique approach, to identify Oakland County's specific traffic problems as a prelude to program development.

A secondary, but important goal of the Information Flow Program category is to develop statewide exposure measures that would adequately define the characteristics of the motoring population. Such exposure data, in combination with the usual accident data, would allow a calculation of valid accident rates (accident rates use accident counts as a numerator and some measure of exposure as a denominator). The consideration of young drivers on rural freeways provides an example of the role of exposure data in countermeasure evaluation. It is well-established that young drivers are overinvolved in accidents and that there are fewer accidents per mile traveled on rural freeways than on city streets. But what about young drivers on rural freeways and city streets? Is it possible that the new driver trained primarily on city streets is particularly prone to accidents on rural freeways? With adequate exposure information the relative involvement of young drivers on city streets and rural freeways can be compared with that of other drivers in similar circumstances. This analysis might point to the need for a specific countermeasure and supply a method for its proper evaluation.

4.2 FEASIBLE COUNTERMEASURES

Specific countermeasures for information flow deficiencies may be categorized into four groups:

(1) Data collection
(2) Data files
(3) Data retrieval and dissemination
(4) Data analysis and utilization

Data concerning the operation of the safety system may be collected at various points in the system and may range from police reports to the detailed information collected by multidisciplinary accident investigation teams. Collection techniques may be employed that permit data to be entered directly into the computer at its source. More uniform and accurate reporting would also be promoted through training programs to help give the local users access to the complicated state-wide data system.

Accident files are fragmented in most states. Driver, vehicle, and highway files are normally maintained in most states, but these files are not integrated into a single file that would permit the cross-referencing of the data for most efficient utilization. Much can be done in the areas of file compatibility, linking, and integration. Welfare and criminal files might also be linked to driver files to promote fair adjudication of the alcoholic driver.

The Traffic Records Standard calls for the rapid audio or visual retrieval of data upon receipt at the records station of any priority request for status of driver license validity or vehicle possession authorization. Rapid retrieval is defined as no more than one minute turnaround time. The use of video terminals in courts mentioned earlier (Section 4 and Ref. 2) is an example of what can be done in this respect.

Accident analysis can be conducted on a single-item basis or on an aggregate basis. Single-item analysis is typified by the study of one driver's complete history, the condition of a specific vehicle, or the pattern of accidents at a given highway location. Aggregate analysis considers large subsets of the entire data bank or the entire data base to determine trends, or to delineate accident patterns not visible in smaller sets of data. The use of exposure data is an important factor in obtaining full utility from the data. A state exposure survey would provide the basis for determining true accident rates. The same survey could also provide information on driver attitudes and other demographic characteristics that would be of value in alcohol control programs or in the Driver Regulation Category discussed in Section 3.

4.3 COUNTERMEASURE EVALUATION

In order to measure the effectiveness of countermeasures in helping to achieve the program objectives (improved data utilization) two types of evaluation parameters can be utilized: one to gauge the flow of information through the system; the other to measure the degree of data utilization.

The flow of information or data through the system can be measured in terms of quantity (e.g., number of accident reports) and quality (goodness). The quality of data, in turn, is measured by a variety of parameters such as timeliness, cost, internal consistency, completeness, accuracy, and compatability. In other data storage and dissemination fields such as library science, quantitative measures are currently being refined for each important parameter. For instance, data compatibility can be computed as the ratio of information items that are needed and are provided by the system for a given task to the number of items that are needed or provided. Thus, if a user is provided five data items and he needed only three, the compatibility of the information would be 3/5.

The degree of data utilization can be measured by the user acceptance of the data supplied by the system. Three levels of user acceptance are important:

(1) The quality of transmission
(2) The informative or semantic understanding of the data
(3) The influence of the information on the user's actions

At the first stage we determine whether the information reached the desired user in a readable form; at the second stage we examine how relevant and usable the information was to the user; at the third stage we determine in what ways, if any, the information influenced the actions of the user.

Such questions have been frequently raised by librarians to determine how to package their information products most efficiently. Quite a wide range of study techniques can be applied. Objective measures can be developed for surveys of users; for instance, accounts of critical incidents can be noted or a record can be kept of the repeated queries by individual users as a measure of acceptance.

5. ROAD USER PREPARATION

Road User Preparation encompasses all those programs designed to raise the performance of individual people, either (a) when they become vehicle operators, passengers, or pedestrians for the first time, or (b) when it has been determined that their performance as a road user requires improvement. Programs of type (a) might be called "initiation activities," and those of type (b) "improvement activities." Initiation includes such activities as teaching young children how to cross roads, training in bicycle usage, educating high-school-aged drivers, and examining drivers for their first license by the state. Improvement activities include advertising campaigns aimed at pedestrians and drivers, driver improvement courses, skid schools, and the process of reexamining drivers. Thus there is an <u>instructional</u> function and an <u>evaluation/examination</u> function in both the initiation and improvement phases of road user preparation. The improvement phase is closely linked with Road User Regulation (Section 3); for example, once a problem driver has been identified by the regulation system, the preparation effort must diagnose the nature of his problem and provide treatment. Applicable sections of the HSP Standards and some specific recommendations are shown in Table V.

5.1 PROGRAM GOALS

Program goals defined more closely than the basic notion that individual performance should be improved are not characteristic of existing "preparation" activities. Part of the reason is that principal components of the preparation system--driver education, driver licensing, propaganda campaigns, and pedestrian and bicycle safety education--are subject to a great deal of public myth. In general, accidents are attributed to a small and very wicked minority of road users whom it is the task of licensing to exclude from driving, and the task of education and re-education to reform. For drivers especially, preparation system goals recognized in the research literature conflict with those recognized by the practitioners (driver license examiners, driver educators, etc.). Figure 4 generalizes the status quo. In the initiation phase, a young driver typically undergoes 30 or 40 hours of driver education which has the expressed objective of making him a "good and safe traffic citizen." He then appears for a state licensing examination which ostensibly screens out the incompetent. Only a tiny minority, however, who cannot demonstrate basic maneuver skills and memorize a number of traffic laws, are actually denied access to the traffic system. Meanwhile, other drivers are referred to driver improvement activities (but rarely through the periodic rescreening process), again with the goal of making them "better traffic citizens."

The criticism implicit in the literature is not that these goals are unworthy, but that as presently implemented they are unworkable. Any preparation system that hopes to act as an accident countermeasure requires program goals related to the known demands of the traffic system on the driver, passenger, cyclist, and pedestrian. Indeed, the overall goals for road user preparation may be summarized as follows:

1. To perform a continuing review of all road-user tasks, particularly by analyzing information gathered within the traffic system.

TABLE V. HIGHWAY SAFETY STANDARDS AND RECOMMENDED ACTIVITIES FOR THE ROAD USER PREPARATION PROGRAM CATEGORY

Standard	Recommended Activities
Driver Education	Each state should have a driver education program for youths of licensing age that is taught by qualified instructors, provides practice driving and qualified instruction, and encourages first-aid training.
	There should be a state research and development program.
	There should be an adult training and retraining program.
	Commercial driving schools should be licensed.
Driver Licensing	Each driver must have only one license, and must submit proof of age and place of birth.
	Each driver must pass an initial examination and be reexamined at periodic intervals.
	A record must be maintained on each driver.
	Each license must be renewed to remain valid.
	There should be a driver improvement program.
	There should be special provisions for handling questions of a medical nature.
Pedestrian Safety	There should be a state-wide program to familiarize drivers with pedestrian problem.
	There should be state-wide programs to educate the public as to safe pedestrian behavior.

2. To periodically update the content of road user instruction, and of any tests or examinations used in the instructional or licensing processes to evaluate road user performance. The aim is to achieve comprehensive coverage while giving priority to sub-tasks which are found to be critical for accident avoidance.
3. To ensure coordination among the various agencies whose functions make up the road user preparation system.

"Content" and "coordination" are the heart of the matter; however, note that meaningful program goals will need to be more specific. They will, in fact, need to define <u>manageable efforts</u> which contribute to the overall goal.

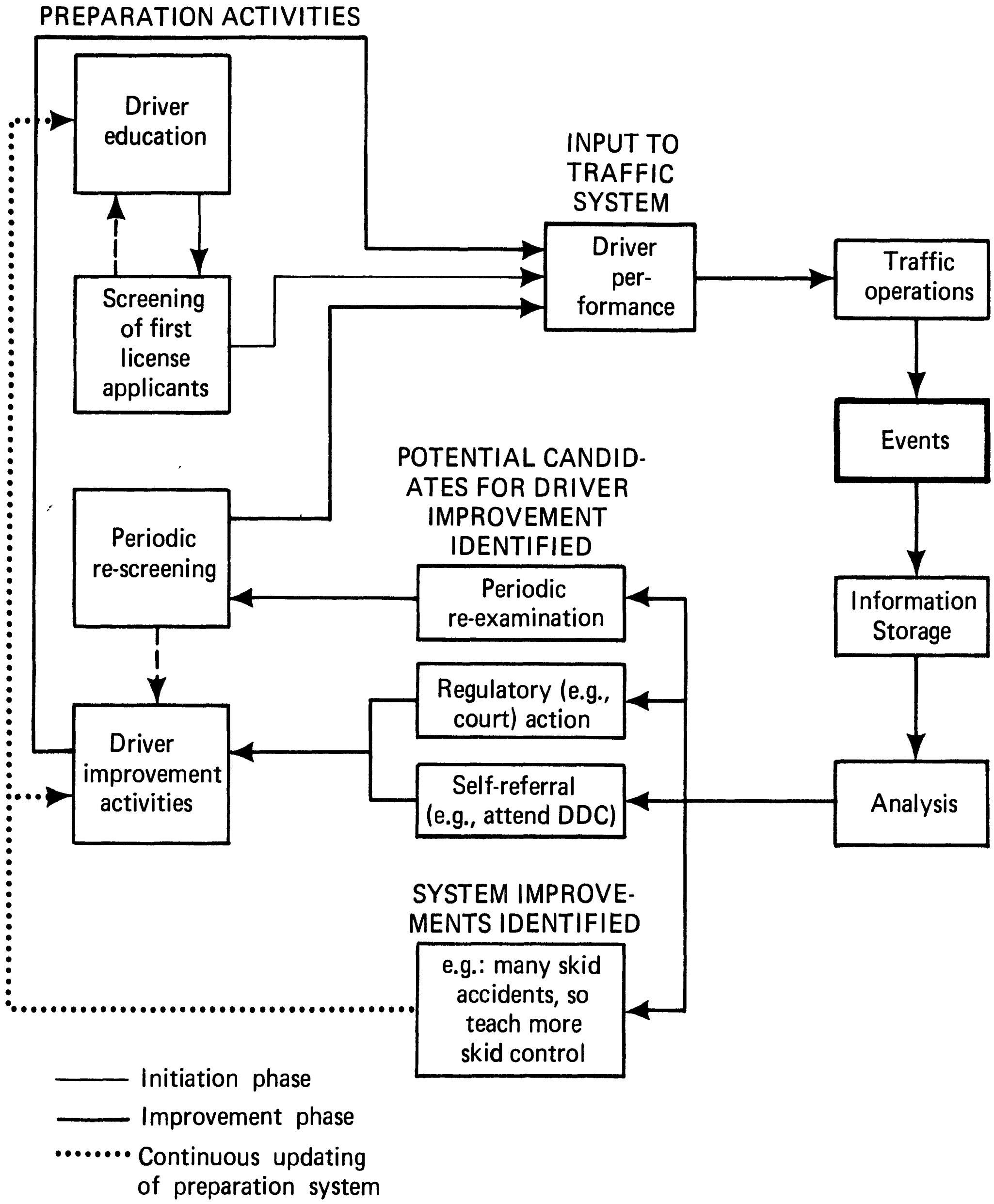


FIGURE 4. THE EXISTING DRIVER PREPARATION SYSTEM

While the principle may seem obvious, it has seldom been followed in practice. In driver education, for example, equipment has too often been introduced in the hope that the program will somehow spontaneously improve. The specification of program goals which identify an area needing improvement, and are achievable and timely, is the essence of sound countermeasure selection.

5.2 FEASIBLE COUNTERMEASURES

In this study, the countermeasure selection criteria described above and in Section 2.3 were not applied in the first instance to the characteristics of specific sites (as a federal or state highway safety program planner might do); rather, we addressed ourselves to the problem of predicting what countermeasures would generally be needed and feasible in the next five to ten years. Our purpose is to illustrate these processes: countermeasure selection; the designation of appropriate evaluation techniques; and the implementation of both. To do this, we could use any of the various road user groups (pedestrians, passengers, bicyclists, and operators of all types of motorized vehicles); however, for illustration purposes, we shall continue to look at the preparation of automobile drivers.

In Section 5.1 various problems with the current effort in driver education, driver examining, and driver improvement were pointed out. In particular, it was noted that overall coordination is poor. The literature contains many recommendations for improving the preparation of drivers, and there is some consensus that the education, improvement, and examining functions could become much more complementary than at present. A synthesis of the recommendations is presented in Figure 5. We feel that the driver preparation effort should work towards the attainment of such a system; at the very least it would provide a cohesive framework for determining the relevance of potential countermeasures. Briefly, Figure 5 suggests certain priorities.

Driver education should be updated along the lines being adopted in many locations following considerable effort by the NHTSA and others to improve our knowledge of the driving task.* There are two dominating trends: One is that greater emphasis is being placed on the mental tasks in driving; the other is recognition of the value of exposing children to the traffic problem as soon as they are old enough to comprehend a TV program, and of continuing the effort beyond formal driver education (for example, "trigger-film" discussion sessions).** The second trend reflects the recognition that if a student is poorly adjusted to driving, this adjustment is likely to be rooted in the whole process of socialization (the development of a so-called "life-style"), which cannot normally be changed significantly in 30 or 40 hours of driving instruction.

The two examination processes--initial and re-examination--should reflect the above changes in driver education content, and as a result offer greater opportunity to diagnose which of the particular subtasks (e.g., perception of hazards, decision-making in critical situations, motor skills, etc.) a driver is having difficulty with. Hence, the neophyte driver can be referred for specific extra help to his instructor. Similarly, the various types of experienced

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*Especially the project "Driver Education Task Analysis" (DOT Contract FH-11-7336), Human Resources Research Organization, Alexandria, Virginia; Volumes I & II, 1970; Volumes III & IV, 1971.

**A technique using films to stimulate discussion in small groups of young drivers; developed by Donald C. Pelz, Survey Research Center, Institute for Social Research, The University of Michigan.

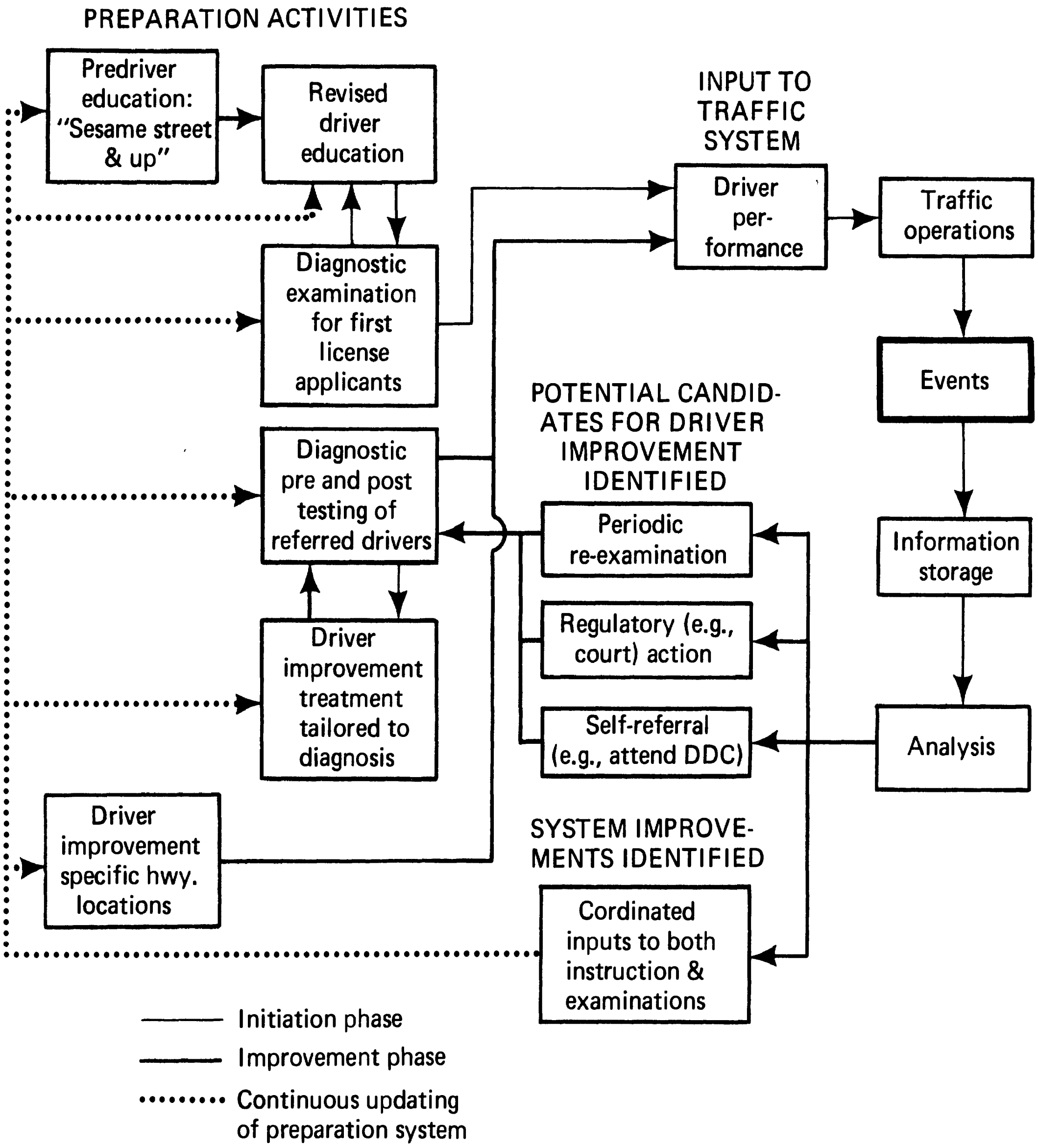

FIGURE 5. AN IMPROVED DRIVER PREPARATION SYSTEM

drivers who are candidates for driver improvement activities (as identified by periodic re-examination, high-point driving records, or even on a voluntary basis) can be referred not to a single treatment, such as a "violators' school," as is so often the case at present, but to one of several alternatives, including counselling, individualized instruction, perceptual training, and behind-the-wheel instruction.

The efforts discussed above are all aimed at upgrading the general performance of drivers. Figure 5 also includes an area of driver improvement aimed at the behavior of drivers at specific highway locations. For example, an experiment in Kentucky used "TV spots" to present local high-accident locations and to advise drivers how best to negotiate them.*

This then is the recommended framework for selecting automobile driver preparation countermeasures. A very similar framework is appropriate for motorcyclists, and even for bicyclists or pedestrians. Although there are normally no formal procedures to examine competency in riding and walking or for issuing licenses, the concept still holds that to adequately prepare road users, we must direct our efforts primarily towards whatever they are having the most difficulty doing. For example, a child pedestrian may well demonstrate that he cannot relate the speed of approaching vehicles to the time it will take him to cross the street; or accident analysis might reveal that many elderly pedestrians are unaware of the need to wear something light-colored when walking after dark; or we might find, by watching and talking to some six- and seven-year-old bicyclists, that they have a very primitive concept of what an automobile driver can and cannot do.

Given these frameworks, how do we identify a "feasible countermeasure?" First, there is a problem with the term. "Countermeasure" could reasonably be used to describe any amount of effort aimed at changing things for the better. In this sense, the whole traffic safety programs package of NHTSA could be called a countermeasure, but then so could the replacement of a bald tire on one automobile. Let us, therefore, define a Road User Preparation countermeasure as a program, or part of a program, which attempts to satisfy some objective which has a more specific definition than "raise the performance level of...." (some target group of road users).

The objectives which we feel to be both possible and timely are implicit in the frameworks just discussed. They have to do mainly with either (a) introducing new content into instruction, public education and propaganda, and testing/examining, or (b) coordinating the various efforts aimed at automobile drivers. However, it is not sufficient to say that a countermeasure is feasible because it consists of some effort which serves (a) or (b) above in a manner acceptable to the local situation; the potential must exist to get at the efficiency and effectiveness of the countermeasure.

Note that it is the effort, not the anticipated outcome, that is the countermeasure. In fact our problem is to implement countermeasures in such a fashion that when we measure the outcome, we are able to say something definitive about the effort. Our overall approach to this is discussed in Section 2.4. Briefly, it is to divide all of the feasible countermeasures into a small number of mutually ex-

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*See: Hutchinson, John W. et al., "An Evaluation of the Effectiveness of Televised, Locally Oriented Driver Reeducation," Kentucky University, 1969, 28p.

clusive groups. Programs are then created to implement one of these groups, or combinations of any or all of them at various levels of intensity. We want to know which combinations have the greatest payoff, and whether it is useful to combine groups at all.

The countermeasure groups we recommend for the concentrated implementation of Road User Preparation countermeasures are:

1. To provide schoolteachers with updated instructional content and methods in the area of pedestrian and bicycle safety, through the development and diffusion of printed materials, and through in- and pre-service training.

2. To provide driver educators and instructors with updated instructional content and methods (including evaluation techniques), through the development and diffusion of printed materials, and through in- and pre-service training. This may pertain to the operation of motorcycles and recreational vehicles.

3. To provide improved equipment and facilities for the instruction of novice motor vehicle operators.

4. To provide driver improvement practitioners and driver license examiners with updated techniques for diagnosing the difficulties of motor vehicle operators, and for ameliorating those difficulties. This to include familiarization with driver education developments, and to be done through the development and diffusion of printed materials, and through in- and pre-service training.

5. To provide improved equipment and facilities for driver improvement and driver license examination activities.

6. To provide additional manpower for driver improvement and driver license examination activities.

7. To coordinate the management of the parallel activities of driver education and training, driver improvement, and driver license examining.

8. To make a comprehensive effort to assist those who control and practice the art of public propaganda of all types in highway traffic safety.

No order of importance is implied by this list. A detailed rationale for the selection of these eight groups will be found in the Road User Preparation section of Volume 3.

5.3 COUNTERMEASURE EVALUATION

It has proven very difficult in the past to evaluate the effectiveness of programs designed to influence road-user behavior. Evaluation techniques fall into three main groups:

(1) Program evaluation: the direct evaluation of the process being used to attempt to change things for the better--primarily the auditing of what goes into the program, including the characteristics of the practitioners who execute it, and the biographical posture of road users affected; it also involves measuring the public's acceptance of the program, and the extent to which it meets their felt needs.

(2) Evaluation of individual proficiency against defined objec-

tives (including instructional objectives)--i.e., paper and pencil tests, skill tests, road tests, etc.; this is the realm of so-called "intermediate criteria."

(3) Evaluation of individual "real world" performance, through unobtrusive, direct observation (e.g. TV monitors, surveillance from following vehicle, etc.) or the judicious use of accident and violation records; this type of evaluation is rather remote from the application of "preparation" countermeasures--it looks at the behavior of ultimate interest.

Ideally, we should like to be able to measure everything we do in terms of (3). But in many cases this is impossible on account of uncontrollable biases in accident and violation records, or simply because too many variables (other than how well a road user is prepared) affect the incidence of accidents and violations.

To date, most evaluation has amounted to questionable use of accident and violation data, and arbitrary assessments of knowledge, attitudes, and skills. What is especially needed is better type (2) evaluation, particularly of driver performance. At this time, we are still lacking adequate basic research tools in driver performance measurement, although one NHTSA contract* is attempting to meet this need, and instrumented vehicles are also proving increasingly useful.

Meanwhile, we can probably do no better than to examine how completely we can measure the various subtasks which make up driving. For example, consider a very simple analytical model (identify-predict-decide-execute) which has become familiar to driver educators, largely through the work of R.W. Bishop (Ref. 4). We used this model (see Figure 6) to define instruments appropriate to (a) the interface between driver and vehicle, and (b) the interface between the driver-vehicle complex and the highway traffic environment. This enables us to select from existing instruments, and to suggest new ones. A strategy of this kind may well help answer some short-term evaluation needs until more rigorous measurement is possible.

*"Development of Driver Performance Measures," DOT Contract No. FH-11-7627, Michigan State University, 1970.

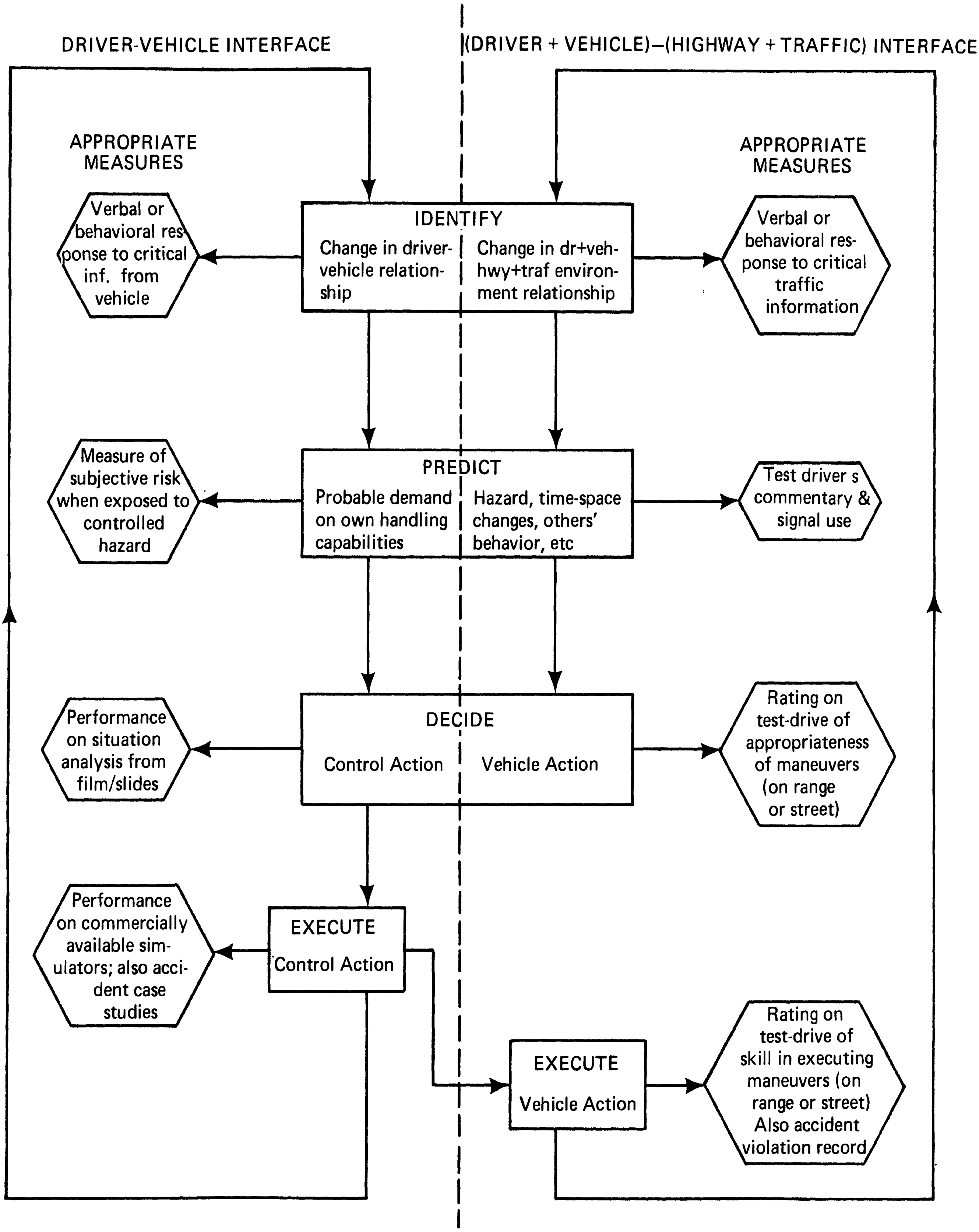

FIGURE 6. MODEL FOR GENERATING MEASURES OF DRIVING SUBTASK PROFICIENCY WHICH CAN BE DEVELOPED WITHOUT EXPENSIVE INSTRUMENTATION

6. VEHICLE REGULATION

Vehicle regulation comprises the set of actions directed specifically toward making vehicles safer to use. Design defects and new manufacturer-produced safety modifications should be included for completeness, but the regulation of vehicles currently in active use by the motoring public is a principal concern. The applicable Highway Safety Program Standards and specific recommendations are shown in Table VI and a system diagram showing the relationship of important factors involved in the vehicle regulation process is shown in Figure 7.

TABLE VI. HIGHWAY SAFETY STANDARDS AND RECOMMENDED ACTIVITIES FOR THE VEHICLE REGULATION PROGRAM CATEGORY

Standard	Recommended Activities
Periodic Motor Vehicle Inspection	Each state shall have a program for the periodic inspection of all registered vehicles or an approved substitute program.
	Each vehicle must be inspected at registration and at least annually thereafter.
	The inspection must be performed by competent, certified personnel.
	Inspection procedures must meet or exceed criteria endorsed by the NHTSA.
	Each inspection station must maintain a set of adequate records.
Motorcycle Safety	Each state shall have a motorcycle safety program that includes a periodic annual inspection of the vehicle as well as an inspection at the time of registration.

Regulation commonly implies inspection but is not limited to this aspect. However, from an examination of Table VI, it is evident that the periodic inspection of each registered motor vehicle is a primary concern of the Highway Safety Program. In practice, then, vehicle regulation is defined as Periodic Motor Vehicle Inspection. This emphasis on inspection strongly affects the possible countermeasures that can be employed in the Vehicle Regulation Program category. This problem will be discussed again in Section 6.2.

In addition to the Highway Safety Program Standards, vehicle-in-use standards strongly influence vehicle regulations.* Further

*Vehicle standards represent a separate NHTSA activity distinct from the state program standards.

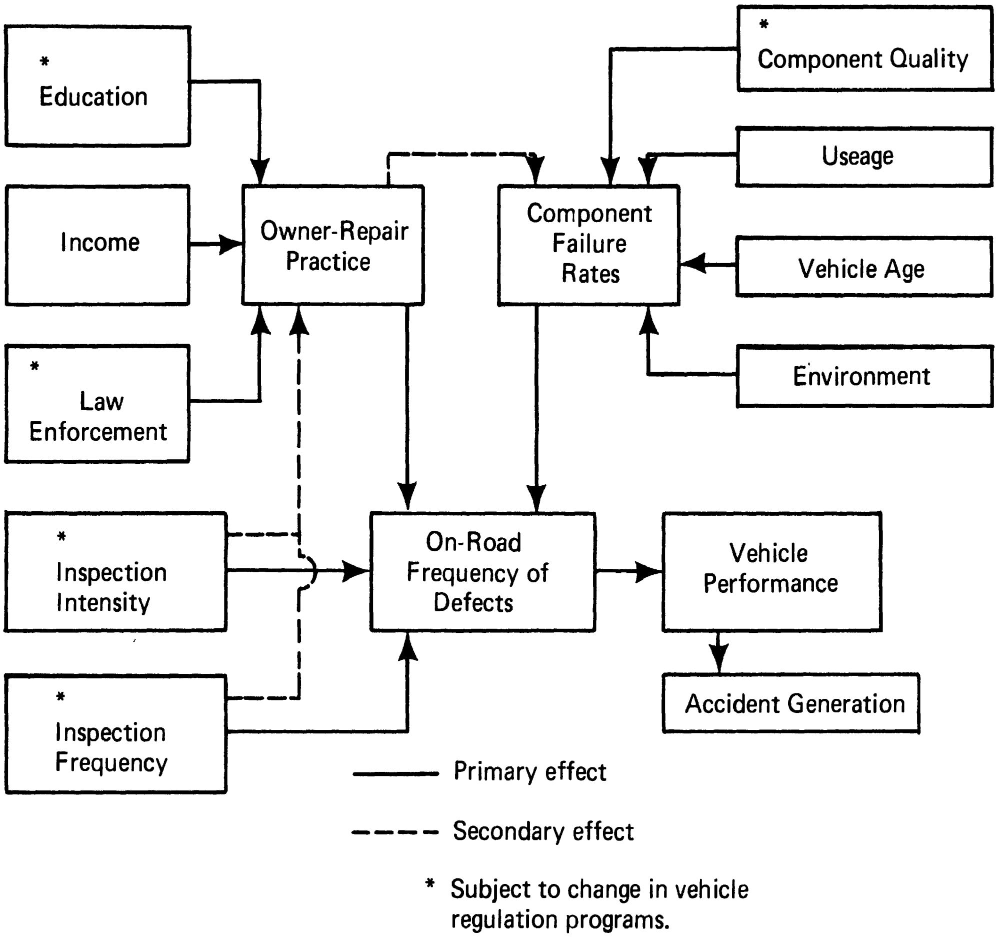

FIGURE 7. VEHICLE REGULATION SUBSYSTEM MODEL

standards (or modifications of existing ones) will eventually include performance criteria for the vehicle-in-use population, certification of automobile maintenance personnel, and a system of owner records and information sources to assist in proper maintenance practices. At latest count, some 33 states have programs for the inspection of all motor vehicles, and another 7 conduct random vehicle checks. The remaining states either have no inspection program or inspect only a limited class of vehicles. A recently released report (Ref. 4) contains an extensive discussion of the different state programs.

The costs associated with owner maintenance include higher initial investment in vehicles, more frequent and more extensive repairs of component systems, stricter enforcement to ensure compliance, and more owner time and effort to comply with the regulations. Benefits may include improved vehicle lifetime, reduced long-term maintenance problems, increased owner peace of mind, and a reduction in accident frequency.

6.1 PROGRAM GOALS

The ultimate goal of vehicle regulation is the reduction in accidents attributable to defective vehicles to the point where additional gains in accident reduction no longer outweigh the cost of improved vehicle performance. This corresponds to a critical degree of application point discussed in Section 2.

In terms of intermediate goals, the principal concern of inspection aspects of vehicle regulation is the reduction of defective vehicle components contributing to accidents. To close the link between intermediate and ultimate goals we must first determine how, and to what extent, vehicle inspection affects the mechanical condition of the operating car population. Then, if mechanical condition is improved, we must determine how, and to what extent, this improvement actually affects vehicle performance (the man-machine interaction). Finally, if performance is improved, we must determine how, and to what extent, that improvement affects the frequency of accidents.

The hypothesis behind the inspection process is that degraded component condition reduces vehicle performance and thus increases the probability of crash involvement. There is little scientific evidence to support this hypothesis. Studies to date have faced methodological and statistical problems that result in questionable or unsubstantiated conclusions. It seems obvious that cars with bald tires or broken brake lines will be over-involved in accidents, but as yet no information exists on the degree of over-involvement.

6.2 FEASIBLE COUNTERMEASURES

As discussed earlier, the inspection requirement appears to be a fixed feature of existing highway safety plans and indeed is mandated by the National Highway Safety Act. Consequently, vehicle inspection constrains the range of applicable countermeasure activities and generates the basic question: how do we achieve the results expected of annual inspection by alternate means?

If vehicle inspection must include annual inspection, a number of alternatives can be explored. Currently, the NHTSA is trying to determine the effectiveness of two alternative forms of inspection: state-run facilities or state-appointed private garages.* Within the two there are a number of differing administrative arrangements that may be applied. Further study of existing systems could determine the effects of such variables as inspection intensity, the number of components checked, and the frequency of inspection. Other measurement programs have been conducted on particular aspects of inspection and such continued measurement and evaluation could form the core of future programs. In brief, the current federal program could serve as a guide for implementation and experimentation in conjunction with an effective use of evaluation techniques such as we have outlined in this report.

Some alternatives to inspection do exist; for example, experimental programs might examine the effect of increased education on owner repair practices; the stricter enforcement of vehicle defect regulations; requirements for owner-maintained vehicle logs and service records; and procedures for better consumer information. The effects of improved component reliability, as proposed by the NHTSA, could be evaluated separately from the effects of inspection. Ideally,

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*DOT contract with Ultra-Systems, Inc., Redondo Beach, Calif.

a number of alternative programs should be operated in parallel to compare relative effects while such factors as vehicle age, owner characteristics, mileage exposure, and environment are controlled.

Based on our review of existing practices and alternative concepts, it seems that a graded set of program alternatives comprise the most feasible countermeasures in the vehicle regulation category at the present time. These alternatives are:

(1) A control experiment
(2) A limited, voluntary inspection program (as proposed in Wisconsin)
(3) A random checklane program with two distinct degrees of enforcement and consequent probability of finding violators
(4) A low-intensity periodic inspection program for all vehicles
(5) A high-intensity periodic inspection program
(6) A full program consisting of all the elements currently outlined by the NHTSA

Within each of these alternatives, before-and-after measurements could be obtained to observe both the short-term effects of the program and the longer-term impact as owners adjusted to a permanent system.

6.3 COUNTERMEASURE EVALUATION

There are three useful ways to determine vehicle condition in an operational environment:

(1) Stop vehicles on the road for a determination of important parameters, or visually observe passing vehicles for obvious fault areas such as lights and glass.
(2) Analyze the inspection statistics.
(3) Perform a diagnostic sampling of vehicles from the existing population.

Spot checking is a relatively inexpensive way to determine the condition of many components. The sampling, if properly done, can be self-adjusting for exposure because the high-exposure vehicles will tend to have a greater likelihood of being stopped. However, random inspection may lack the necessary equipment or consistency of measurement found in a controlled garage. Furthermore, such measurements may be extremely sensitive to the site selected for the experiment. One project conducted at the Highway Safety Research Institute uncovered a 100% variation indefects detected between two observation points three miles apart on the same thoroughfare (Ref. 5).

Inspection statistics are useful in evaluating the effectiveness of inspection, but must be used with caution since they contain two possible sources of error. First, they may reflect a fix-before-inspection phenomenon which masks the true condition of the vehicle during the service period. Second, there may be wide variations in inspection criteria and inspection severity among different facilities. This may be true despite efforts to ensure uniform inspection standards and consistent enforcement.

Diagnostic inspection of selected vehicle population samples represents the purest form of measurement. The required random sample can be drawn from the registration rolls and the vehicles can then be located and inspected. This technique provides both uniformity of measurement and a source of potentially unbiased data. Unfortunately, securing the cooperation of a large number of vehicle owners may be costly in time, manpower, and inducements or rewards.

A final measure of countermeasure effectiveness might be a survey of owners to determine if the introduction or continuation of a particular program has changed their maintenance practices. This measure would be significant because the success of any program for regulating vehicle performance depends largely on the voluntary participation of owners. If a program produces negative attitudes, much of its effect will be vitiated.

7. SYSTEM RESTORATION

The System Restoration program category is primarily concerned with immediate responses to an accident situation as indicated in the highway safety diagram of Figure 1. The applicable Highway Safety Program Standards and specific recommendations are shown in Table VII. Considered jointly, the standards require that states and local jurisdictions provide adequate systems for responding to highway accidents where injured persons require medical attention and wreckage, or other debris requires cleanup and removal. These actions are taken not only to save the lives of those persons injured in the accident, but to prevent the occurrence of further accidents caused by the confusion and wreckage of the first.

Figure 8 diagrams the relationship between important actions in the System Restoration program operations. In this figure, the double solid lines represent the movement of men and equipment; single lines represent the command and communication channels; and dashed lines represent the actions of police and the system adminstration. Five basic operations are evident in Figure 8:

(1) The detection of an Event and communication of its detection to appropriate agencies.
- Police patrol
- Observation by private citizens
- Two-way radio
- Telephone

(2) The dispatch of men and equipment sufficient to handle the emergency conditions.
- Ambulance
- Tow truck
- Radioactive waste decontamination crew

(3) Treatment of the emergency conditions at the site.
- Extraction of injured from the wreckage
- Application of basic first aid
- Removal of wrecked vehicles and debris
- Cleanup of spilled hazardous materials

(4) Transportation from the accident scene.
- Removal of injured to permanent care facilities
- Removal of wrecked vehicles to the storage point

(5) Return of emergency equipment to its ready status.
- Vehicles returned to their dispatch point
- Fire extinguishers refilled
- First-aid supplies refurbished

In contrast to the five remaining program categories, System Restoration deals with fast-response reactions to the occurrence of an accident or other event so that time is an important factor. In order to prevent further injury, it is necessary that the appropriate actions be performed as quickly and efficiently as possible.

7.1 PROGRAM GOALS

Because the System Restoration Program is directed toward the solution of a readily visible problem (i.e., the accident), the goals can be stated quite concisely. The principal goal of the emergency medical system is the delivery of the injured to a facility that can provide definitive care in a manner that maximizes a favorable prognosis and minimizes morbidity. Similarly, the principal

TABLE VII. HIGHWAY SAFETY STANDARDS AND RECOMMENDED ACTIVITIES FOR THE SYSTEM RESTORATION PROGRAM CATEGORY

Standard	Recommended Activity
Emergency Medical Services	Each state shall have a program to insure that persons involved in highway accidents receive prompt medical care.
	There should be training and license requirements for ambulance operators, attendants, drivers, and dispatchers.
	There should be requirements for the operation and coordination of vehicles and supplies.
	There should be first aid training programs for emergency service personnel.
	There should be criteria to govern the use of two way communications.
	There should be established procedures for summoning and dispatching aid.
	There should be an up to date, comprehensive plan for emergency medical services.
Debris Hazard Control and Cleanup	Operational procedures should be established to enable rescue and salvage equipment to get to the scene of accidents quickly and to operate efficiently on arrival; for extricating trapped persons; for warning approaching drivers of the hazards present on the roadway; for safely handling the spillage of hazardous materials; and for removing wreckage or spillage from the highway.
	Adequate numbers of rescue and salvage personnel must be trained and retrained in the latest accident cleanup techniques.
	A communication system must be provided to coordinate efforts in detection, notification, dispatch, and the response of appropriate services.

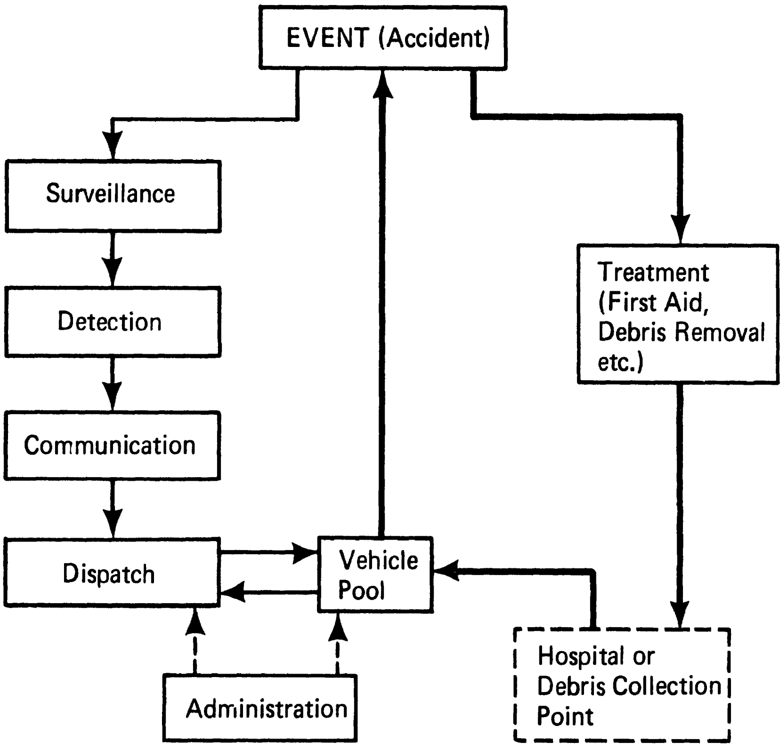


FIGURE 8. ESSENTIAL OPERATIONS OF THE SYSTEM RESTORATION PROGRAMS

goal of the debris cleanup system is the removal of wreckage and hazardous materials from the highway system in a manner that minimizes the likelihood of another accident and maximizes the traffic flow around the accident scene.

A great amount of work has been done in trying to accomplish these goals in large urban areas (Detroit, New York City, Los Angeles, Miami, Pittsburgh, Boston, and Philadelphia) and at the state level of government (Arizona, Mississippi, and Nebraska). Although these programs have not resulted in a complete explanation of the problems involved in restoration systems at the state or urban government level, it is a conclusion of this study that the efforts of future demonstration programs can be most profitably used at the county level. For the rural or semi-rural areas there seems often to be a greater need for improvement and consequently a better chance for measurement of countermeasure effectiveness

7.2 FEASIBLE COUNTERMEASURES

From a review of the literature as well as from past efforts in restoration, four activity categories appear important for countermeasure deployment. These categories are:

(1) Detection and notification procedures and equipment
(2) Training of personnel
(3) Use of new emergency equipment
(4) Planning and administration changes.

These categories are readily identifiable with the task areas of Figure 8.

Detection and communication processes are performed in most communities by private citizens using the one channel available to virtually all citizens--the telephone. Communications can be greatly improved by the use of a two-way radio system so that police and emergency vehicles can contact one another. A further refinement can be added through the use of a central coordination and dispatch center that can handle incoming telephone and radio requests, allocate the available emergency equipment and personnel, and dispatch the chosen units. In addition to serving as a central communications link, the coordination center also adds a degree of overall planning to the emergency system deployment scheme. Direct (or relayed) communications between ambulance and hospital is also a feasible notification technique for alerting hospital personnel to an anticipated crisis situation. However, this requires well-trained ambulance attendants who can properly diagnose the criticality of an emergency condition.

The training of medical attendants, dispatchers, cleanup crews, vehicle drivers, and the general public is an important technique in upgrading personnel in the proper handling of emergency situations. It is particularly important now because of the great variety of new and complicated equipment not familiar to the uninformed. A variety of training courses exists in the first-aid field, and corresponding courses can be set up for training in debris cleanup and the handling of hazardous materials. Refresher courses are also a valuable training technique, since many potentially serious conditions (such as chemical spillage) do not occur very frequently, so that proper procedures may be forgotten by the time the need to use them arises.

The use of helicopters as emergency vehicles in a restoration system has been examined in a number of programs. Consequently, it was concluded that they have been used in enough ways to determine their worth, and that their use in future programs could be minimized. New ambulance and emergency vehicle designs exist, however, so that these vehicles could serve as adequate countermeasures in the new equipment area.

Proper management of the restoration system is essential to its effective usage. Consequently, some changes in the overal control of operational activities will generally be well worth the cost involved. Since a county level experimental approach is suggested, a county-wide agency should be responsible for the management of system operation, allocation of resources, and relationships with the rest of the safety system. A variety of management aids could be used to help this agency make the required decisions (i.e., computerized optimal allocation of emergency vehicles and analyzed reports from the information system.)

7.3 COUNTERMEASURE EVALUATION

As discussed earlier, time is an important parameter in the operation of restoration systems. As a result, the critical times involved are important intermediate criteria for the system operation. These critical times define the onset of various events that occur in response to an accident. In order of occurrence they are:

(1) Time of occurrence
(2) Detection time
(3) Reporting time
(4) Dispatch time
(5) Arrival time
(6) Departure time
(7) Hospital arrival time
(8) Return-to-service time

Detection delay is the time required for the detection and recognition of the incident by an agent who may report it to the system; it includes the time necessary to reach the decision that an emergency must be reported. Reporting delay is the time required to gain access to a communication channel and to notify the dispatch center. The sum of the detection and reporting delays may be referred to as a notification delay.

The dispatch delay and the transit-to-scene delay are self-explanatory. Their sum will be called the response delay and is related to the administration and policy of the emergency vehicle service. The remaining delay times (time at scene, transit to hospital delay, delay at hospital) are not closely dependent upon system configuration, but are usually uniquely determined by the geographical distribution of emergency and medical facilities.

The other factor important to restoring system operation is the quality of treatment and care provided at the scene of the accident or in transit. For the medical services area, measures of morbidity or mortality may be possible in a sufficiently large experiment. It is not expected that the number of fatalities will provide a reliable measure for a county-sized area, but morbidity measures such as number of days in the hospital, degree of permanent impairment, or total cost of recovery may be taken as measures of effectiveness in a sufficiently large jurisdiction.

In the debris cleanup system, countermeasure effectiveness may be evaluated by measuring the degree to which traffic is affected by the wreckage at the accident site (i.e., traffic conflicts at the accident point and upstream from it, number of incidents caused by debris, etc.) but the most applicable method is expected to be a subjective appraisal of case studies.

8. HIGHWAY REGULATION

Highway regulation is concerned with safety system activities related to highway design (i.e., highway geometrics), traffic control devices, and that portion of the pedestrian safety problem that deals with hardware (cross walks, lights, etc.). To prevent any possible diversion of safety program funds for highway construction purposes, program efforts in this category have generally been limited to surveys and evaluation studies, inventories of existing conditions, or operation of training programs. Nevertheless, it is obvious that there will be activities aimed at improving defective highway designs, replacing inadequate signing, and protecting pedestrians. These programs should be included in the evaluation methodology to define and refine methods for measuring countermeasure effectiveness.

At the same time, several aspects of the Highway Regulation Program category are significantly different from the corresponding condition found in the other five categories discussed earlier in this report. First, the requirements imposed by the applicable standards (Highway Construction, Design, and Maintenance; Traffic Control Devices; and Pedestrian Safety) are numerous and quite specific in their content. Second, the evaluation of highway-related problems is already at a relatively advanced level when compared to some of the other standard areas.

Because specific recommendations of the Highway Safety Program Standards are so numerous, it is difficult to propose any sort of experimental design that could encompass a significant number of countermeasure groups in a single program. For instance, the Highway Design, Construction, and Maintenance Standard proposes eleven requirements for adoption by the states. In addition, it is very likely that site requirements would preclude the implementation of a number of these countermeasure groups at a single geographic location. That is, highway design problems are located where highways are located, not just where people are found, as is true of driver regulation problems.

A study of the highway literature also reveals a large number of ongoing efforts to evaluate and upgrade the conditions of our nation's roads. Some of these efforts are marginally useful, but many others have contributed significantly to the state of knowledge in the Highway Regulation Field. Over the period that highway construction has been an important activity in this country, a number of channels have developed for the collection, evaluation, and dissemination of research and evaluation studies. For instance, the Highway Research Board regularly publishes and presents critiques of new studies.

As a result of these considerations, it is our opinion that a distinct SCOPE-type experiment is not justified in the Highway Regulation category. What is needed here is an organizational effort to insure an overall uniformity of effort in the evaluation programs. The organizational plan should consider the following topics:

1. What is the current state of effort?
   What has been done?
   What is currently being done?
2. How are the research efforts deployed?
   Are all areas of interest under study?
   Are some areas receiving too much attention?

3. How are the evaluation studies being conducted?
Is the evaluation credible?
Is the evaluation plan of Section 2 followed in major aspects?

In essence, we suggest that the program planning considerations presented in Section 2 be used as a long-term guide to implement safety programs in the highway category. Thus, new or proposed programs would be examined to see where they fit in the program implementation matrix (see, for example, Figure 3), and to determine their suitability in terms of the evaluation outlines presented in Section 2 of this report. By following a master plan of this sort, needless duplication of effort could be avoided, better evaluation results could be obtained in many cases, and a high degree of comparability of results would be attained.

In order to demonstrate how a program in the Highway Regulation category might be designed, however, a highway signing experiment will be used for purposes of discussion in this section and in the corresponding detailed program plan presented in Volume 3 of this report. There is considerable current interest in signing--particularly on freeways and beltways--and a significant amount of effort has been expended in developing measures of effectiveness for highway modifications. Consequently, this was felt to be a timely subject, and one that would provide a medium for displaying our suggested program evaluation techniques.

The remainder of this section will present the program design considerations for a signing experiment. Bear in mind that this is a suggested design prototype for the entire Highway Regulation category.

8.1 PROGRAM GOALS

The following excerpt of highway signing principles is taken from the AASHO Interstate Signing Manual:

> The design for signs of the Interstate System must be approached on the premise that the signing is primarily for the benefit of drivers who are not familiar with the route or area. Signs must contain messages appropriate to the needs of these drivers. The sign legend must be carefully selected and designed for easy reading and the signs themselves must be prominently and effectively displayed at the proper location so that drivers will tend to react promptly, naturally, and safely to the traffic and design conditions encountered.

This statement expresses a realistic appraisal of needs for the use of signing on interstate highway systems, but does not indicate in detail how the criteria for sign legends, placement, etc. is derived. In pursuit of the primary program goal, therefore, the secondary goals relative to sign criteria are important. Before it is possible to erect signing that is potentially capable of significantly affecting the traffic situation at a given highway site, it is necessary to know the relationship between the parameters of the signing practices used (placement, color, size, legend, etc.), and the resulting traffic patterns induced. As discussed in Section 2, the <u>why</u> of the action is highly important if the results are to be extrapolated to other locations and conditions.

Traffic control evaluation studies have evoked considerable interest in recent years in the use of new measures of effectiveness for countermeasures. Notable among these are traffic conflicts, acceleration noise, and galvanic skin response. A Highway Regulation program could provide valuable information to the traffic safety community by studying the relationship between these intermediate criteria and the ultimate criterion of accident reduction.

8.2 FEASIBLE COUNTERMEASURES

Within the confines of the program limitations given above, countermeasures for the Highway Regulation Program category are signs to direct motorists to their desired destination in unknown areas and often under tension-filled circumstances. The signs should be constructed in accordance with the best modern engineering practice, and may include many parameters for evaluation, such as size, color, shape, placement, and type of legend. In particular, the use of diagrammatic signing has received much favorable attention lately.

8.3 COUNTERMEASURE EVALUATION

Because the modification of highway signs involves a direct component change, this type of countermeasure is susceptible to rather direct measures of effectiveness i.e., accident reduction (Ref. 6) . Thus, for a sufficiently large sample size (see Section 2.5) there is a good possibility that a direct relationship between countermeasure and accident reduction may be found.

In recent years a number of intermediate measures of countermeasure effectiveness have been proposed and tested. In summary, these techniques are aimed at relating the accident potential of a given highway section to certain characteristics of the traffic using that section. Measuring these characteristics for a given section of highway should make it possible to define its accident potential without waiting for the accident statistics to accumulate. The Traffic Conflict technique attempts to provide the necessary relationship by determining the number of "conflicts" that occur in the traffic stream. Conflicts are usually defined as any potential accident situation, and are identified by lane changes to avoid collision, use of brake lights, etc. The Acceleration Noise technique utilizes a turbulence-like measure of traffic flow to detect potentially unstable conditions that may occur at critical points in the traffic stream. Some other techniques such as the Galvanic Skin Response have been used at times, but have not received as much attention as the two techniques mentioned above.

Although these methods have not been successful in determining the accident potential of a site in a quantative fashion, they have demonstrated their worth in providing an intermediate measure of countermeasure utility. In addition to an evaluation of the signing techniques used in a demonstration program, the use of these intermediate measures along with the conventional ultimate criteria could provide further refinement of their effectiveness.

9. SELECTING COUNTERMEASURE PROGRAM EVALUATION SITES

Any contact with state or local government agencies quickly leads to the impression that some are capable of doing good program evaluation work, and some are not. This capability should be taken into consideration when sites are selected for either evaluating existing countermeasure programs or implementing new programs that require evaluation. Any effort expended in choosing sites carefully on the basis of their ability to perform adequately as program evaluators will yield good returns in the form of reliable evaluation information.

Two types of factors are useful in selecting sites for countermeasure evaluation programs. First are those related to material characteristics. Such factors might be requirements for sites (e.g., cities) within a certain size range; in a certain part of the country; with a collection of certain data already on hand; with a certain countermeasure program already implemented; or some similar specification or set of specifications. Identification and evaluation of such factors is straightforward and will not be discussed here.

The second type of factors is that related to the managerial or organizational characteristics of the agencies chosen for program operation. These have to do with the agencies' overall ability to do any program evaluation work of acceptable quality. Factors that might be important in this respect, for example, are a willingness to experiment, sufficient level of skill at evaluation, or freedom from disrupting changes in other agencies. In the discussion below, factors of this nature will be related to criteria used in site selection, and suggestions will be offered concerning their use in the site selection process.

9.1 THE SITE SELECTION PROCESS

The manner by which sites are selected is important in determining what selection criteria are feasible to use. Two assumptions have been made about the agencies in each of the potential sites: they have the necessary material characteristics for the particular project they might "host"; and they have submitted a proposed evaluation program to the group responsible for site selection.

The selection process necessary to narrow the potential sites to just these few should have several stages, as illustrated in Figure 9. First, the NHTSA regional administrators are given the list of projects that will eventually be placed in a city, county, state, or other agency (each project has a list of material specifications that must be satisfied by the agency taking it on) and are asked to select agencies in their area that meet these requirements. Here use should be made of the network of governor's representatives. The result of combining these lists from all regional administrators, with additions from the Washington office, is a list of potential sites for each countermeasure project. The next step involves sending RFP's to these agencies, specifying the characteristics of the proposed countermeasure project(s) they might host, the commitments that would be required of them, the level of funding that would be available, the reporting necessary, etc. The Request for Proposal (RFP) would require information on the facilities available, past experiences with project evaluation, the staff to be assigned the evaluation task, and other important information. Selection of the site for each countermeasure project would then be made on the basis of these proposals, the information collected at a brief site visit, and the opinions of the state and regional NHTSA personnel. The group

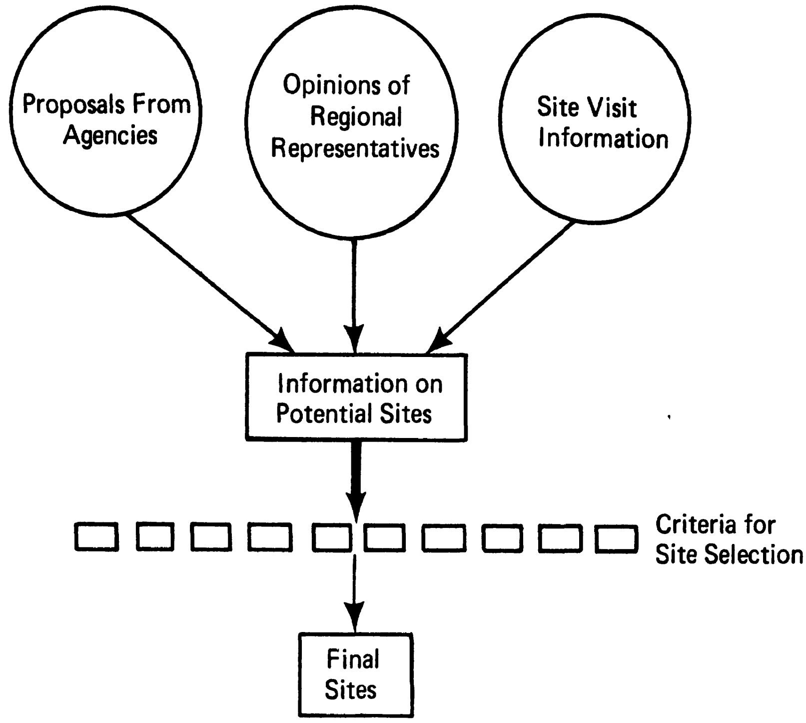


FIGURE 9. THE SITE SELECTION PROCEDURE

assigned the job of making the final selections will have to decide what information is most useful and reliable in selecting places likely to generate high-quality evaluation information.

9.2 USE OF THE SELECTION CRITERIA

The criteria are presented in Table VIII as a guideline for the group assigned the task of making the final site selections, and are keyed to a checklist of indicators known to be important in determining whether an agency is able to participate constructively in an evaluation effort.* The term "checklist" is used because no strong priorities could be established among the various indicators, and because they contain some overlap and duplication. Some of these indicators will be more important than others depending on the particular project or type of agency under consideration. The guidelines in Table VIII are organized into three category-columns: (1) the major criteria one should investigate that relate to each of the criteria, (2) the "indicators" of the criteria, and (3) the possible sources of the information about each indicator.

The criteria (there are four of them) are major agency characteristics one should look for during the selection process.

The indicators are clues--the actual characteristics of the agency--useful in finding out something about the criteria. For example, to estimate whether or not an agency is likely to be com-

*The checklist was generated by interviewing 19 individuals having experience in program evaluation (approximately half in the highway safety area) plus a review of written material relevant to the evaluation process.

TABLE VIII. CRITERIA CHECKLIST FOR PROJECT SITE SELECTION

Criteria	Indicators	Sources
Tolerance to experimentation (is the agency able to tolerate the uncertainty and negative feedback implicit in experimentation?)	Past history of innovation and/or change	Proposal, reputation
	Cooperation with educational institutions in the community (do they make use of what is there?	Reputation
	Staff with evaluation experience	Resumes
	Expressed willingness and enthusiasm	Proposal, visit
	Evidence of younger staff (are they all old?)	Resumes, visit
	Extent of staff travel and attendance at conventions (do they get around?)	Reputation, visit
	Diversity of community (are staff members used to handling different people, community organizations?)	Reputation, visit
	Moderate or high status for evaluation work (does everyone look down on program evaluation?)	Budget, 403 history, reputation
Interest in, and commitment to, good evaluation (does the agency want the evaluation information that will be produced, and will it commit itself to getting it?)	Positive proposals for the use of evaluation information (are they going to just shelve it when they are done?)	Proposal
	Cooperation with other agencies and/or the community (do they work in isolation?)	Proposal, reputation
	Adequate staffing (is the staff big enough? Does it have the proper support?)	Proposal, budget
	Specific performance objectives (are they clear about what they are going to do?)	Proposal

Criteria	Indicators	Sources
Interest...(cont.)	Evidence of planning within the host agency (are they used to thinking ahead?)	Reputation, visit
	Evidence of some structure in the agency that is responsible for program evaluation (is someone directly responsible for doing it?)	Proposal, reputation, visit
	Adequate existing records and procedures for their use (do they make use of the data they collect?)	Visit, proposal
Ability to perform evaluative work (does the agency have the skills and resources necessary to produce quality evaluation information?)	Staff with training or experience in evaluation	Resumes
	Cooperation with universities, other agencies in the community	Reputation, proposal
	Past evaluation work of high quality	Documentation, reputation
	Sufficient control over important program factors (do they have enough power to set up the proper conditions?)	Proposal, reputation
	Sufficient staff and other resources (are they going to run out of money before they are finished?)	Proposal, budget
	High quality proposal (have they thought the problems through?)	Proposal
	Good informal communications with other agencies (can they communicate easily and efficiently?)	Reputation, visit
	Overlap between the proposal authors and the project staff (are those who wrote it going to implement it?)	Proposal, visit

Criteria	Indicators	Sources
Ability...(cont.)	Visible leadership in the agency (can they direct their effort?)	Reputation, visit
Stability of environment (is the agency an environment conducive to experimentation and/or evaluation?)	Sufficient control over the important program factors (are they able to maintain a stable program?)	Proposal, reputation
	Freedom from inter- or intra-agency conflict or corruption (are they going to have to fight anybody off in order to do their job?)	Reputation
	Specific objectives for agency performance (do they think in terms of objectives, and do they think stability is important?)	Proposal, visit, reputation

mitted to doing good evaluation work, one might look at such things as what they propose to do with the information after it is obtained, how much time or money will be spent doing evaluation, how successful their past projects have been, etc.

The sources of information are the places one might look to learn something about each indicator. There may be other or better sources, but those listed below are suggested as a set of the most likely sources:

(1) The proposal.
(2) Staff resumes.
(3) Project and agency budgets.
(4) 402 and 403 project budgets.
(5) Documentation of previous projects.
(6) Reputation in other organizations (such as among state or regional representatives, professional organizations, other agencies in the area, or whoever else might know something about them).
(7) Observations from a site visit.

If a group responsible for the final selection is able to identify more or better sources of information, these sources should be exploited.

9.3 THE MOST IMPORTANT INDICATORS

Certain characteristics can be placed in a high-priority list on the basis of how often they are considered important by evaluators. Although others might be more important in particular circumstances, these probably tell quite a lot about an agency in an average situation:

(1) A history of innovation and change
(2) Staff with backgrounds involving program evaluation
(3) Effective cooperation with local education institutions
(4) A specific proposal for use of the data from an evaluation project
(5) An adequate use of existing records and data.

(These are all contained as indicators in Table VIII above.)

Careful consideration of criteria such as these (and the others in Table VIII will lead to better evaluation information in the end. Agencies which score high on this list of indicators will most likely tolerate program evaluation, show commitment to carrying it through, have the skills to do it right, and be in a position to do the best job possible.

Appendix A
COMPUTER FILE OF 402 PROJECTS

The National Highway Traffic Safety Administration has funded over four thousand State and Community Highway Safety (Section 402) Projects to encourage adoption of the Highway Safety Program Standards. These projects originate at state and local levels, and consequently tend to reflect indigenous interests and capabilities in the countermeasures area. They also provide useful information about current programs and indicate potential sites for new demonstration programs. One task of the present contract requires the development of a computer-based file of these projects in order to facilitate analyses of current activities.

Information about existing 402 projects was provided by the NHTSA in the form of voluminous computer printouts; one contained financial data while another gave a one-line description of each project. The applicable state, standard area, and fiscal year for each project were also identified. The one-line descriptions were coded according to seven parameters chosen to aid in a search of projects having particular characteristics germane to countermeasure demonstrations. This information was keypunched and established as a standard Statistical Research System tape file. In this form information about NHTSA 402 projects is readily available for analysis through standard data-processing programs.

Table IX is the Dictionary for the completed file, and identifies twenty-nine variables used to describe each project. Much of this data is redundant, but has been incorporated in different forms to aid in running analysis programs and to simplify the interpretation of results. There are essentially three classes of data: 1) identification (variables #1 through #15); 2) financial (variables #16 through #21); and 3) descriptive (variables #22 through #29).

The identifying information consists of location by state, standard area, fiscal year, and NHTSA project number. Total project cost, federal funds authorized, and federal funds spent constitute the three pieces of financial data. The seven descriptive parameters are: (1) novelness--departure from existing conditions; (2) degree of implementation--position along the research/operational dimension; (3) hardware content; (4) type of implementing organization; (5) user group(s) toward which the project is oriented; (6) training aspects involved; and (7) geographical coverage of the project. The specific categories and code values used are listed in the Code Book given in Appendix B. Coding of the descriptive parameters was based upon the one-line description of each project included in an abbreviated form as variable #29. The effective date of this data (as indicated on the NHTSA printouts) is July 30, 1970. Updating or additions to this file can be accomplished quite easily.

The file presently contains 4254 cases. However, 414 cases (9.7%) pertain to existing projects submitted as a "soft match" for federal funds in other areas. Since these projects tend not to reflect new activities or embrace federal commitments, they have been generally omitted from analysis. Also, the printouts received are current to different dates so there are 45 cases for which financial data are missing.

Analyses of these data tend to be of two kinds: either a display of some variable or set of variables across all of the data, or an examination of a selected subset of the data based upon a specific set of criteria. For example, questions about the level of funding for different standards in the several states are typical

TABLE IX. DICTIONARY--402 (STATE & COMMUNITY HIGHWAY SAFETY) PROJECTS FILE

Variable Number	Code Values	Missing Data Code	Explanation
1. case ID number	(9 digits)	---	Combination of V3, 4,11, & 14
2. date of data	(6 digits)	---	Mo-da-yr of source printout
3. state	01-52	---	See code book
4. standard	00-16	---	See code book
5. state-1st digit	0-5	---	For running analysis programs
6. state-2nd digit	0-9	---	For running analysis programs
7. standard-1st digit	0-1	---	For running analysis programs
8. standard-2nd digit	0-9	---	For running analysis programs
9. fiscal yr-1st digit	6-7	---	For running analysis programs
10. fiscal yr-2nd digit	1,7-9	---	For running analysis programs
11. fiscal year	67-71	---	Year grant was made
12. state abbrev	4 alpha char	blank	For data listings
13. standard abbrev	4 alpha char	blank	For data listings
14. NHSB proj #	001-909	---	Assigned by NHSB
15. type of proj	0-9	---	'9' defines in lieu of matching funds proj
16. tot proj cost (in \$ x 10^{-5})	000-998	999	1st 3 digits V19
17. fed fund auth (in \$ x 10^{-5})	000-998	999	1st 3 digits V20
18. fed fund spent (in \$ x 10^{-5})	000-998	999	1st 3 digits V21
19. total proj cost (in \$ x 10^{-3})	00001-99899	99999	Indicates level of effort
20. fed fun auth (in \$ x 10^{-3})	00000-99899	99999	Usually ½ of V19
21. fed fund spent (in \$ x 10^{-3})	00000-99899	99999	Spent as of date in V2
22. novelness	0-6	9	See code book
23. degree implementation	0-6	9	See code book
24. hardware content	00-14	99	See code book
25. implementing organiz	00-12	99	See code book
26. user group(s)	00-18	99	See code book
27. training aspects	0-5	9	See code book
28. geographical coverage	0-8	9	See code book
29. proj description	59 alpha char	blank	Annotated from NHSB listing

of the first type of analysis. An example of the second type might be to ask for a list of all novel projects in Driver Education at a local level not involving the purchase of equipment. The remainder of this appendix will describe some characteristics of these data derived from various analyses of the first type.

The first analysis task was to identify areas of greatest activity (both standard areas and states). For this, univariate and bivariate frequency distributions of projects in the various standards and states were constructed. In summary, this analysis showed that 31.4% (1,336) of the projects are in the area of Police Traffic Services (Standard #15), and that Illinois and Massachusetts each had nearly 10% of the total number of projects (421 and 396, respectively). There are no projects in the area of Motorcycle Safety (Standard #3), and the District of Columbia had the fewest number of projects--14.

Although of interest, counts of the number of projects are a rather crude indicator of activity; an analysis of funding probably gives a more accurate indication of the level of effort involved. Both total project cost and federal funds authorized have been examined. Although the "402" projects are ostensibly matching fund grants, a "soft match" has been used in many cases, and a somewhat different picture emerges on a project-by-project basis, depending upon which of these figures is used. For consistency the "federal funds authorized" figure has generally been used. It is felt that this figure will tend to reflect more clearly the allocation choice of new monies from the fixed total authorization for each state. In general, total project costs are twice the value of federal funds authorized. Presumably, a comparison of federal funds authorized and federal funds spent would indicate the degree of completion; however, it appears that projects are sometimes terminated without spending the total authorization.

Based upon federal funds authorized, the largest expenditures are in the area of Traffic Records (Standard #10) with 21% (roughly $37,100,000) of the "402" federal funding to date. Driver Education (Standard #4) and Police Traffic Services (Standard #15) are a close second and third with 19.8% and 17.9%, respectively. Although in terms of the number of projects they are ranked 5, 2, and 1, these three standards account for 58.7% of all federal funds authorized and 52.1% of all projects to date. New York, California, Ohio, Texas, and Pennsylvania, in that order, are the five states with the largest values of federal funds authorized. Funding limitations have been established by Congress primarily on the basis of population so that one would expect the funding figures derived from the "402" file to be essentially a reflection of the size of each state. However, the "402" derived funding figures, and even their rank ordering, are only in rough agreement with statutory limitations.

The next analysis topic was an investigation of the distribution of funding for different standards within each state, and the relative involvement of the states in each of the standard areas. The results of these analyses are presented as the maps and bar graphs collected in Appendix C.

Both the maps and bar graphs of Appendix C provide a quick visual summary of the relative activity of different areas, and have proved very helpful in identifying directions for further analysis. Tabular listings of the number of projects and federal funds authorized by standard area and by state have also been prepared as a basic reference for these analyses.

Appendix B
CODE BOOK--SEC. 402 PROJECTS

VARIABLES #3 (STATE NO.) AND #12 (STATE ABBREV.)

State	Abbrev.	Code	State	Abbrev.	Code
Alabama	ALA	01	New Hampshire	NH	27
Arizona	ARIZ	02	New Jersey	NJ	28
Arkansas	ARK	03	New Mexico	NM	29
California	CAL	04	New York	NY	30
Colorado	COLO	05	North Carolina	NC	31
Connecticut	CONN	06	North Dakota	ND	32
Delaware	DEL	07	Ohio	OHIO	33
Florida	FLA	08	Oklahoma	OKLA	34
Georgia	GA	09	Oregon	ORE	35
Idaho	IDA	10	Pennsylvania	PENN	36
Illinois	ILL	11	Rhode Island	RI	37
Indiana	IND	12	South Carolina	SC	38
Iowa	IOWA	13	South Dakota	SD	39
Kansas	KAN	14	Tennessee	TENN	40
Kentucky	KEN	15	Texas	TEX	41
Louisiana	LA	16	Utah	UTAH	42
Maine	ME	17	Vermont	VER	43
Maryland	MD	18	Virginia	VIR	44
Massachusetts	MASS	19	Washington	WASH	45
Michigan	MICH	20	West Virginia	WV	46
Minnesota	MINN	21	Wisconsin	WISC	47
Mississippi	MISS	22	Wyoming	WYO	48
Missouri	MOU	23	Alaska	ALSK	49
Montana	MONT	24	Hawaii	HAWI	50
Nebraska	NEB	25	District of Col.	DC	51
Nevada	NEV	26	Puerto Rico	PR	52

VARIABLE #4 (STANDARD #) AND #13 (STANDARD ABBREVIATION)

Standard	Abbrev.	Code
Planning and Administration	P & A	00
Periodic Motor Vehicle Inspection	PMVI	01
Motor Vehicle Registration	MVR	02
Motorcycle Safety	M/C	03
Driver Education	DE	04
Driver Licensing	DL	05
Codes and Laws	C & L	06
Traffic Courts	TC	07
Alcohol in Relation to Highway Safety	ALC	08
Identification and Surveillance of Accident Locations	IDAL	09
Traffic Records	TR	10
Emergency Medical Service	EMS	11
Highway Design, Construction and Maintenance	HDCM	12
Traffic Control Devices	TCD	13
Pedestrian Safety	PS	14
Police Traffic Services	PTS	15
Debris Hazard Control and Cleanup	DHC	16

VARIABLE #22--NOVELNESS--DEPARTURE FROM EXISTING CONDITIONS	Code
Degree of novelness undefined or of no meaning	0
Continuation of present functions--no change in technique or procedure involved (also matching or state funds, etc.)	1
Specifically a continuation of a previous 402 project (special case of code #1)	2
Expansion or improvement in capability of an existing project or program--function enhanced but otherwise unchanged	3
Revision or modification of an existing project or program--function significantly changed	4
Conversion from manual to automated operation specifically specified (special case of codes #3 or 4)	5
Study, develop, or implement a new program, procedure, or system--provide a capability not previously present	6

VARIABLE #23--DEGREE OF IMPLEMENTATION	Code
Degree of implementation undefined or of no meaning	0
Level of implementation unaffected by project or routine or normal operation stated or implied	1
Project culminates in feasibility study or before-the-fact system analysis	2
Provides for survey, inventory, or data collection	3
Culminates in recommendations, plan, or proposed operating criteria or procedures	4
Institutes a prototype, trail, experimental or developmental operation	5
Provides for evaluation or after-the-fact analyses	6

VARIABLE #24--HARDWARE CONTENT	Code
Hardware content undefined or of no meaning	00
Hardware considerations specifically not involved	01
Hardware involved but not specified	02
Procurement of:	
diverse equipment necessary for implementation of project specified	03
surface transport vehicle(s) specified (car, ambulance, truck, motorcycle,..)	04
other-than-road transport vehicle(s) specified (helicopter,...)	05
communications equipment	06
measuring or monitoring equipment used as an enforcement aid (speed-measuring equipment, breathalyzer,....)	07
combinations of equipments used as enforcement aid (combinations of speed measuring, vehicle, communications equipment,....)	08

(continues)

(Variable #24, contd.)
Procurement of:

surveillance or monitoring equipment other than enforcement aids (traffic counters, TV surveillance,...)	09
measuring or testing equipment used for mechanizing operations (visual acuity, scoring of test,....)	10
educational or training aids (simulator, audio-visual,....)	11
optical data recording or retrieval equipment (microfilm, photographic cameras, projectors,...)	12
medical aid equipment	13
electronic data processing equipment (key punch, terminal, computer, optical character recognition,....)	14

(Procurement includes purchase, lease, or obtaining the use of, in some way)

VARIABLE #25--IMPLEMENTING ORGANIZATION(S)	Code
Implementing organization undefined or of no meaning	00
Diffuse, complex, or multiply involved organizational arrangements	01
Motor vehicle registration agencies	02
Driver licensing agencies	03
Highway or public road agencies	04
Law enforcement agencies	05
Courts or legal agencies	06
Legislative or governmental agencies	07
Educational agencies	08
Researchers or consultants	09
Service organizations (auto clubs, safety institutes,....)	10
Emergency medical agencies	11
Motor Vehicle Inspection agencies	12

VARIABLE #26--USER GROUP(S)	Code
User group not specified or of no meaning	00
Stated or implied that user group is same as implementing organization	01
AS DISTINGUISHED BY DRIVER TYPE	
General driving public	02
Beginning or inexperienced driver	03
Experienced driver	04
Handicapped or disadvantaged drivers	05
Traffic offenders	06
Professional drivers (chauffeur, taxi, truck, bus,...)	07

(continues)

(Variable #26, contd.)

AS DISTINGUISHED BY MODE OF TRAVEL

Pedestrian	08
Bicyclist	09
Motorcyclist	10
Passenger	11

AS DISTINGUISHED BY ORGANIZATIONAL AFFILIATION

Motor vehicle administration personnel	12
Highway engineering personnel	13
Law enforcement personnel	14
Judiciary or legislative personnel	15
Training personnel	16
Service organization personnel (auto clubs, community interest groups,...)	17
Emergency medical personnel	18

VARIABLE #27--TRAINING ASPECTS	Code
Training not involved, unspecified, or of no meaning	0
Training involved but not specifically defined	1
Preparation of manuals or instructional materials	2
Training in the use of new equipment, techniques, or processes specified	3
Project primarily for the training of some user group	4
Conferences, briefings, or familiarization sessions	5

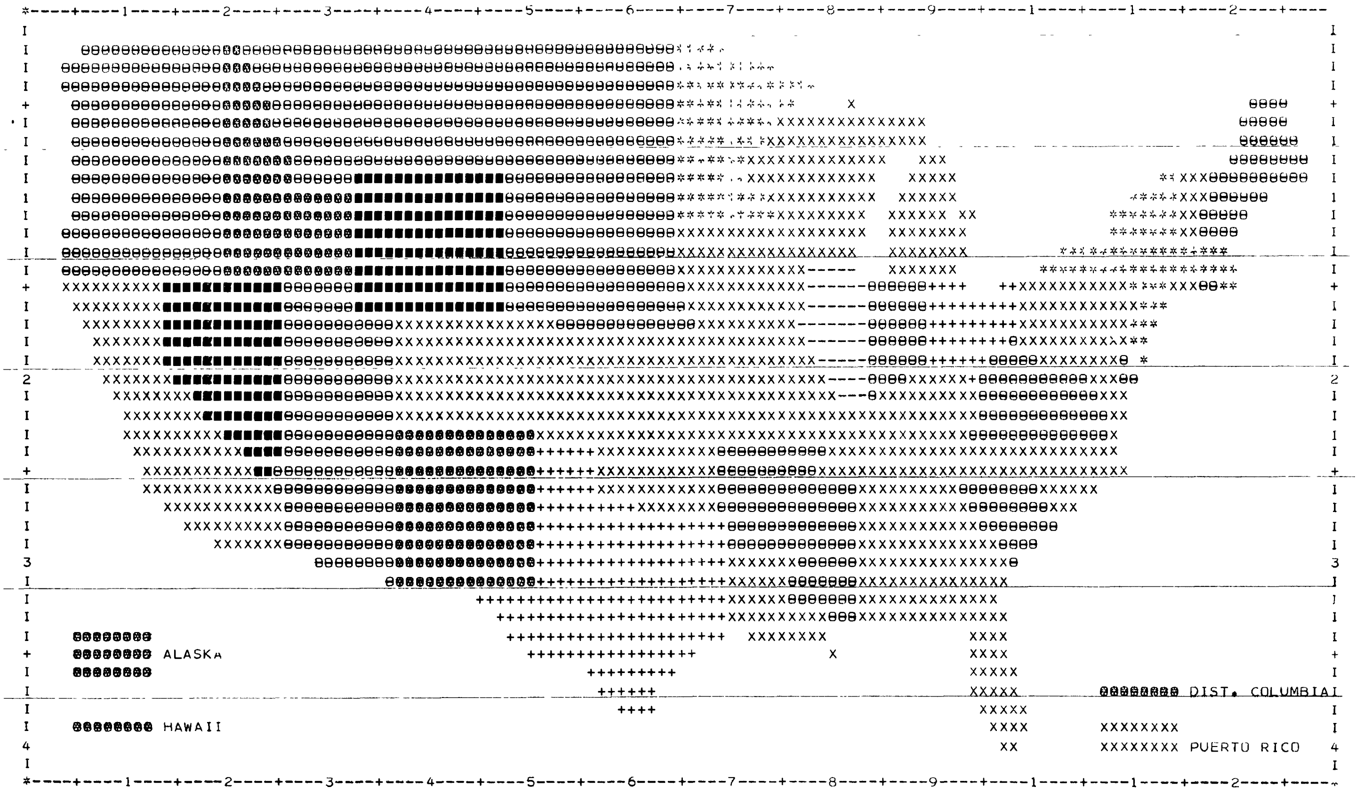
VARIABLE #28--GEOGRAPHICAL COVERAGE	Code
Extent of project unspecified--state-wide coverage implied	0
Extent of project unspecified--less than state-wide coverage implied	1
State-wide coverage specified	2
County-wide coverage specified	3
Metropolitan area coverage specified (pop. 50,000 or more)	4
Local area coverage specified (town, village, small city)	5
State/county coverage specified	6
County/city or county/local coverage specified	7
Coverage of 3 or more geographical groups specified	8

Appendix C
THE DISTRIBUTION OF 402 FUNDING BY SAFETY STANDARD AND STATE

Seventeen computer-generated maps (one for each standard plus planning and administration) were prepared through a special map drawing program to display the percentage of each state's total authorized federal funds for the particular standard area concerned. The darker shadings indicate a higher percentage of the state's funds for the standard involved. That is, the data displayed are in fractions, the numerator of which is the sum of federal funds authorized for projects within a particular standard area, and the denominator of which is the total value of federal funds authorized for all projects within that state. These maps, then, depict the relative emphasis that each state had placed upon a particular standard area. Data value extremes, the data range applying to each display level, and the frequency of data points within each display level, are given below each map. A geometric variation in the range of values for each display level was selected so as to get a reasonably good spread of the data and to help single out extremes. The same scaling factor is used on all maps to enable comparisons among the different standards.

The accompanying bar graphs are based upon the same data used in constructing the maps; however, the portrayal is of the distribution of funds according to standards within states. There are 52 bar graphs (one for each state plus the District of Columbia and Puerto Rico). The abbreviation of each state and the federal funds authorized for all projects within that state (in thousands of dollars) are given at the top of each graph. The height of each column is proportional to the percentage of the state's total federal funds in each of seventeen areas (the 16 standards, plus planning and administration). For most of the graphs the ordinate scale runs from 0% to 50%; however, if any one column exceeds 50% the scale is from 0% to 100%. The value (in thousands of dollars) of federal funds in each of these areas is also shown at the top of each column, and the abbreviation for each standard is given at the foot of the columns. The standards have been grouped into the six proposed program areas and read from left to right:

- Planning and Administration (P&A)
- Information Flow--consisting of:
  - Motor Vehicle Registration - MVR
  - Identification and Surveillance of Accident Location - IDAL
  - Traffic Records--TR
- Driver Preparation--consisting of:
  - Driver Education--DE
  - Driver Licensing--DL
  - Pedestrian Safety--PS
- Driver Regulation--consisting of:
  - Codes and Laws--C&L
  - Traffic Courts--TC
  - Alcohol in Relation to Highway Safety--ALC
  - Police Traffic Services--PTS
- Vehicle Regulation--consisting of:
  - Periodic Motor Vehicle Inspection--PMVI
  - Motorcycle Safety--M/C
- Highway Regulation--consisting of:
  - Highway Design, Construction, and Maintenance--HDCM
  - Traffic Control Devices--TCD
- System Restoration--consisting of:
  - Emergency Medical Service--EMS
  - Debris Hazard Control and Cleanup--DHC



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C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C PLANNING AND ADMINISTRATION, FY68 THRU FY70 (HSP STANDARD 4.4.0)

DATA VALUE EXTREMES ARE 0.0 39.61

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7
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FREQ.	1	2	4	20	18	5	2

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    2            I++2++I    I**3**I    IXX4XXI    I88588I    I886881    I■■7■■I
    3                       I**3**I    IXX4XXI    I88588I    I886881
    4                       I**3**I    IXX4XXI    I88588I    I886881
    5                                  IXX4XXI    I88588I    I886881
    6                                  IXX4XXI    I88588I
    7                                  IXX4XXI    I88588I
    8                                  IXX4XXI    I88588I
    9                                  IXX4XXI    I88588I
   10                                  IXX4XXI    I88588I
   11                                  IXX4XXI    I88588I
   12                                  IXX4XXI    I88588I
   13                                  IXX4XXI    I88588I
   14                                  IXX4XXI    I88588I
   15                                  IXX4XXI    I88588I
   16                                  IXX4XXI    I88588I
   17                                  IXX4XXI    I88588I
   18                                  IXX4XXI    I88588I
   19                                  IXX4XXI
   20                                  IXX4XXI
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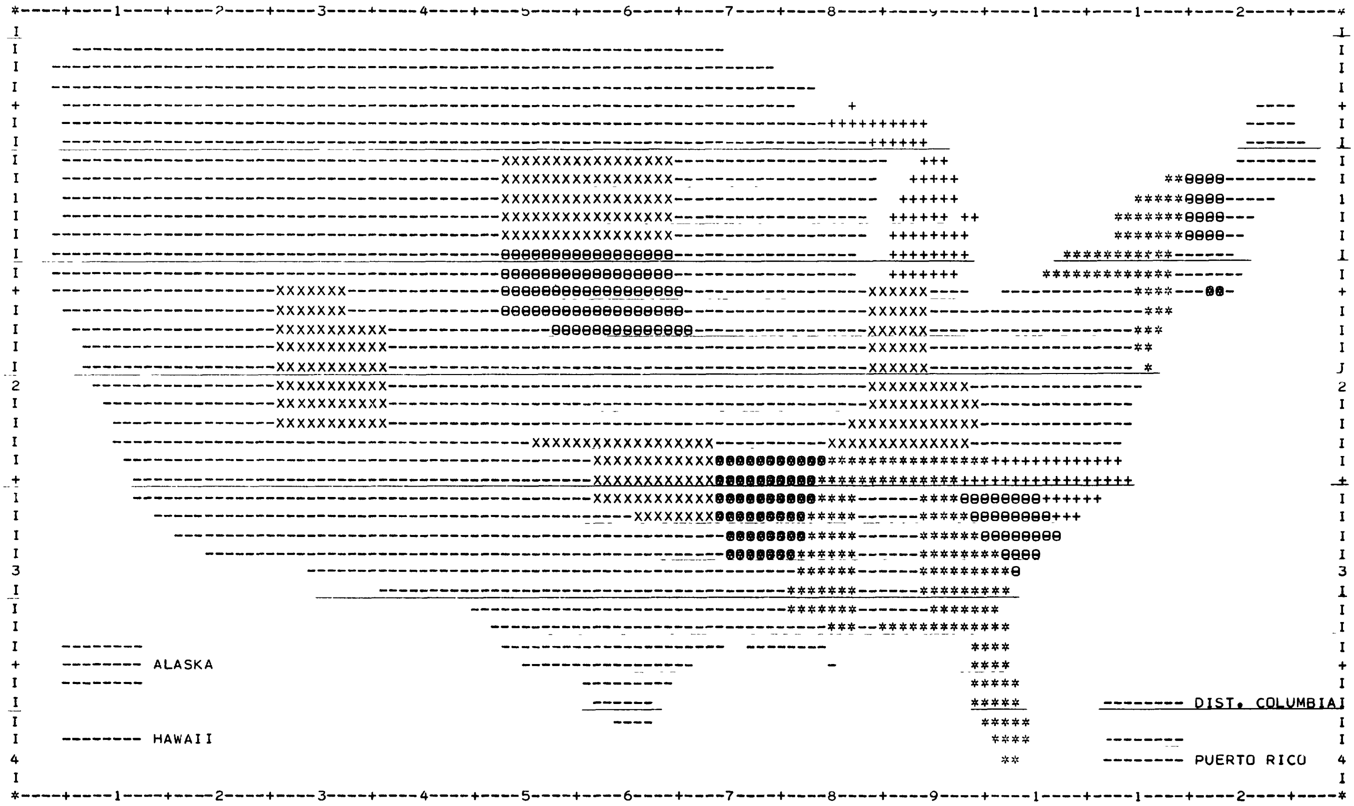

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C PERIODIC MOTOR VEHICLE INSPECTION, FY68 THRU FY70

C (HSP STANDARD 4.4.1)

DATA VALUE EXTREMES ARE 0.0 24.58

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
  LEVEL        1         2         3         4         5         6         7
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          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 █████████
  SYMBOLS ----1---- ++++2++++ ****3**** XXXX4XXXX 0000500000 00006000 ████7████
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 █████████
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 █████████
          =================================================================
  FREQ.       33        2         6         5         4         2         0
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        2  I--1--I  I++2++I  I**3**I  IXX4XXI  I005001  I006001
        3  I--1--I           I**3**I  IXX4XXI  I005001
        4  I--1--I           I**3**I  IXX4XXI  I005001
        5  I--1--I           I**3**I  IXX4XXI
        6  I--1--I           I**3**I
        7  I--1--I
        8  I--1--I
        9  I--1--I
       10  I--1--I
       11  I--1--I
       12  I--1--I
       13  I--1--I
       14  I--1--I
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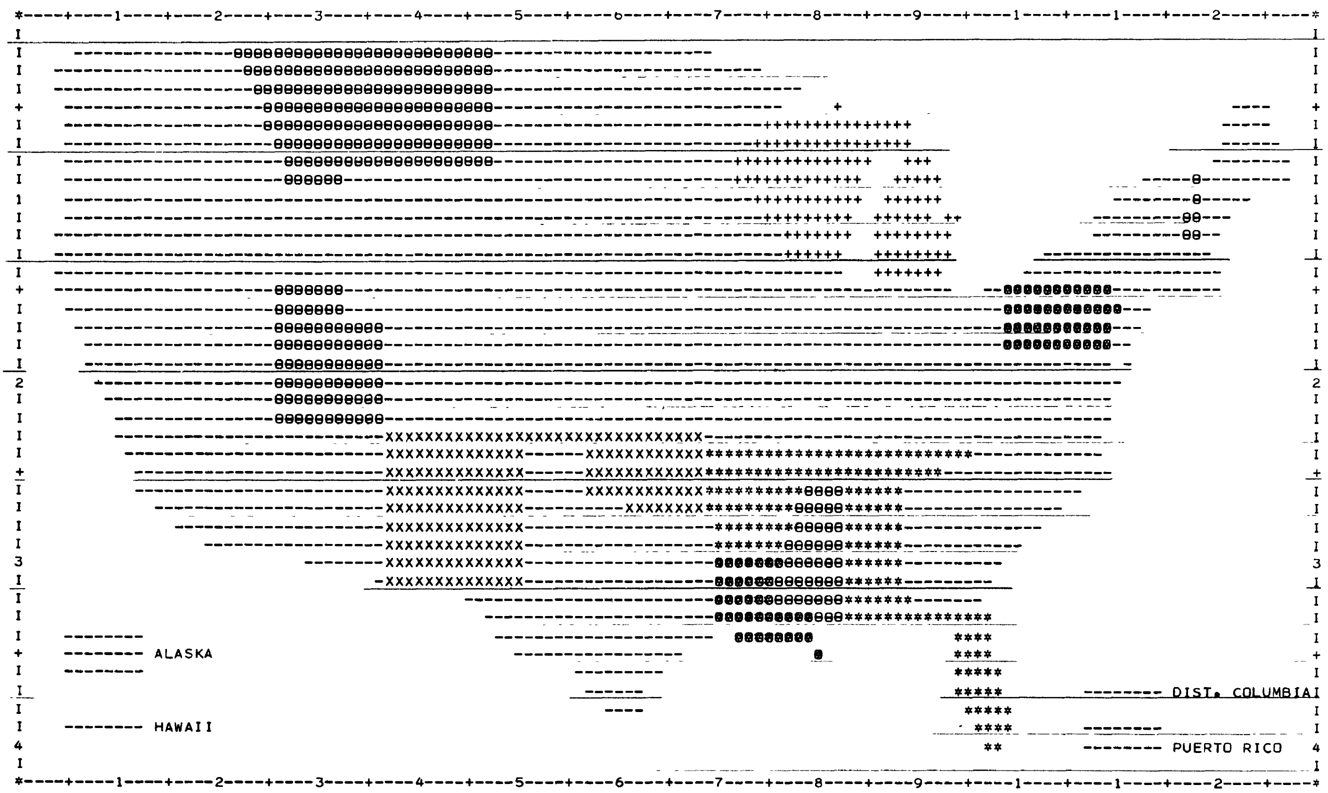

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C MOTOR VEHICLE REGISTRATION, FY68 THRU FY70 (HSP STANDARD 4.4.2)

DATA VALUE EXTREMES ARE 0.0 28.12

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

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MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

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LEVEL        1         2         3         4         5         6         7
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          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
SYMBOLS   ----1---- ++++2++++ ****3**** XXXX4XXXX 0000500000 00006000 ■■■■7■■■■
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
          ======================================================================
FREQ.        38         2         4         2         4         2         0
       1  I--1--I   I++2++I   I**3**I   IXX4XXI   I00500I   I00600I
       2  I--1--I   I++2++I   I**3**I   IXX4XXI   I00500I   I00600I
       3  I--1--I             I**3**I             I00500I
       4  I--1--I             I**3**I             I00500I
       5  I--1--I
       6  I--1--I
       7  I--1--I
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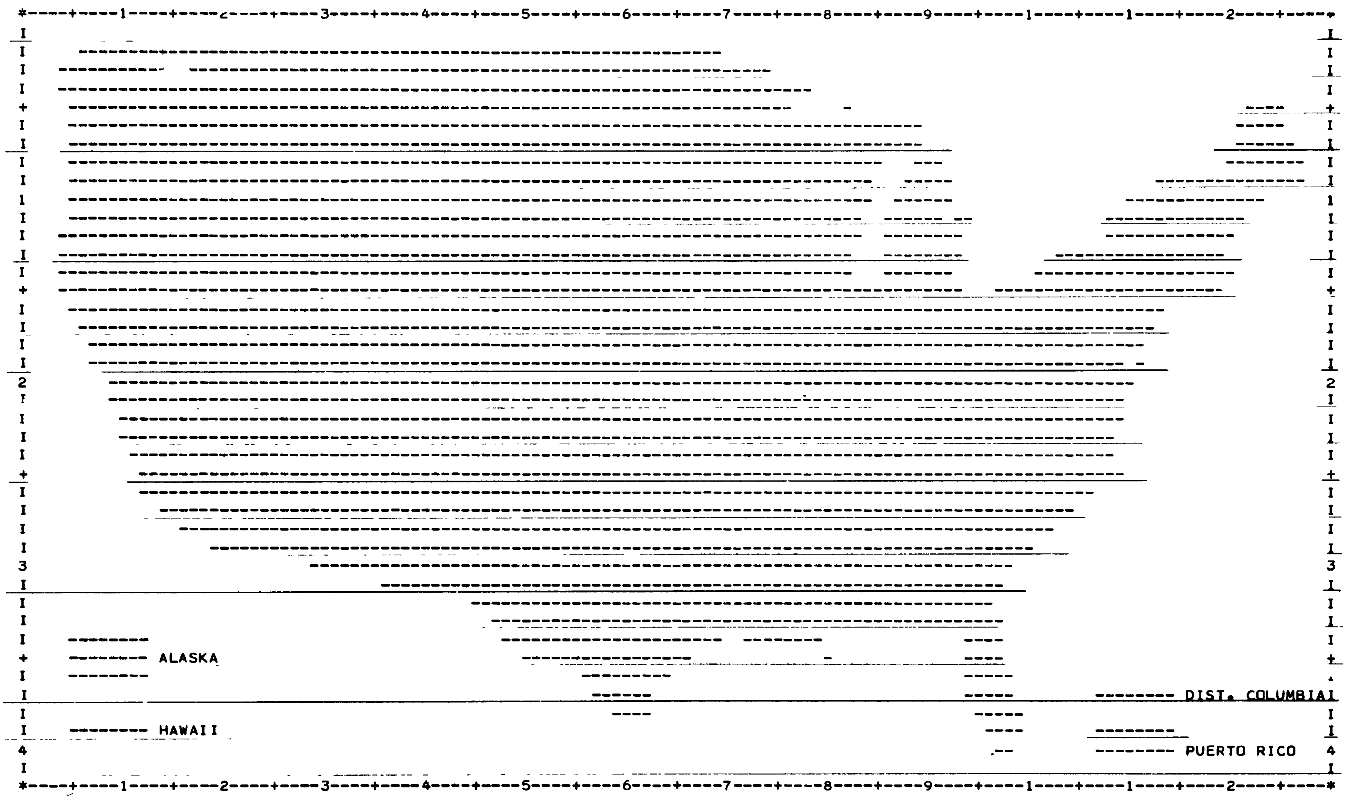

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C MOTORCYCLE SAFETY. FY68 THRU FY70 (HSP STANDARD 4.4.3)

DATA VALUE EXTREMES ARE 0.0 0.0

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM 0.0
MAXIMUM 100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

100.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

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SYMBOLS	----1----
FREQ.	52

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SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C DRIVER EDUCATION, FY68 THRU FY70 (HSP STANDARD 4.4.4)

DATA VALUE EXTREMES ARE 0.56 52.12

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
LEVEL         1          2          3          4          5          6          7
          ==============================================================================
          ---------  +++++++++  *********  XXXXXXXXX  θθθθθθθθθ  @@@@@@@@@  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  θθθθθθθθθ  @@@@@@@@@  ■■■■■■■■■
SYMBOLS   ----1----  ++++2++++  ****3****  XXXX4XXXX  θθθθ5θθθθ  @@@@6@@@@  ■■■■7■■■■
          ---------  +++++++++  *********  XXXXXXXXX  θθθθθθθθθ  @@@@@@@@@  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  θθθθθθθθθ  @@@@@@@@@  ■■■■■■■■■
          ==============================================================================
FREQ.         0          1          2          4          17         21         7
     1                I++2++I    I**3**I    IXX4XXI    Iθθ5θθI    I@@6@@I    I■■7■■I
     2                           I**3**I    IXX4XXI    Iθθ5θθI    I@@6@@I    I■■7■■I
     3                                      IXX4XXI    Iθθ5θθI    I@@6@@I    I■■7■■I
     4                                      IXX4XXI    Iθθ5θθI    I@@6@@I    I■■7■■I
     5                                                 Iθθ5θθI    I@@6@@I    I■■7■■I
     6                                                 Iθθ5θθI    I@@6@@I    I■■7■■I
     7                                                 Iθθ5θθI    I@@6@@I    I■■7■■I
     8                                                 Iθθ5θθI    I@@6@@I
     9                                                 Iθθ5θθI    I@@6@@I
     0                                                 Iθθ5θθI    I@@6@@I
    11                                                 Iθθ5θθI    I@@6@@I
    12                                                 Iθθ5θθI    I@@6@@I
    13                                                 Iθθ5θθI    I@@6@@I
    14                                                 Iθθ5θθI    I@@6@@I
    15                                                 Iθθ5θθI    I@@6@@I
    16                                                 Iθθ5θθI    I@@6@@I
    17                                                 Iθθ5θθI    I@@6@@I
    18                                                            I@@6@@I
    19                                                            I@@6@@I
    20                                                            I@@6@@I
    21                                                            I@@6@@I
```

TIME = 0.0

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C DRIVER LICENSING, FY68 THRU FY70 (HSP STANDARD 4.4.5)

DATA VALUE EXTREMES ARE 0.0 26.98

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL         1          2          3          4          5          6          7
            ===================================================================
            ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
            ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
 SYMBOLS    ----1----  ++++2++++  ****3****  XXXX4XXXX  @@@@5@@@@  @@@@6@@@@  ■■■■7■■■■
            ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
            ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
            ===================================================================
 FREQ.        10          7          9          7          11         8          0
          1  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          2  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          3  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          4  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          5  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          6  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          7  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
          8  I--1--I               I**3**I               I@@5@@I    I@@6@@I
          9  I--1--I               I**3**I               I@@5@@I
         10  I--1--I                                     I@@5@@I
         11                                              I@@5@@I
```

TIME = 0.0

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C CODES AND LAWS, FY68 THRU FY70 (HSP STANDARD 4.4.6)

DATA VALUE EXTREMES ARE 0.0 5.88

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

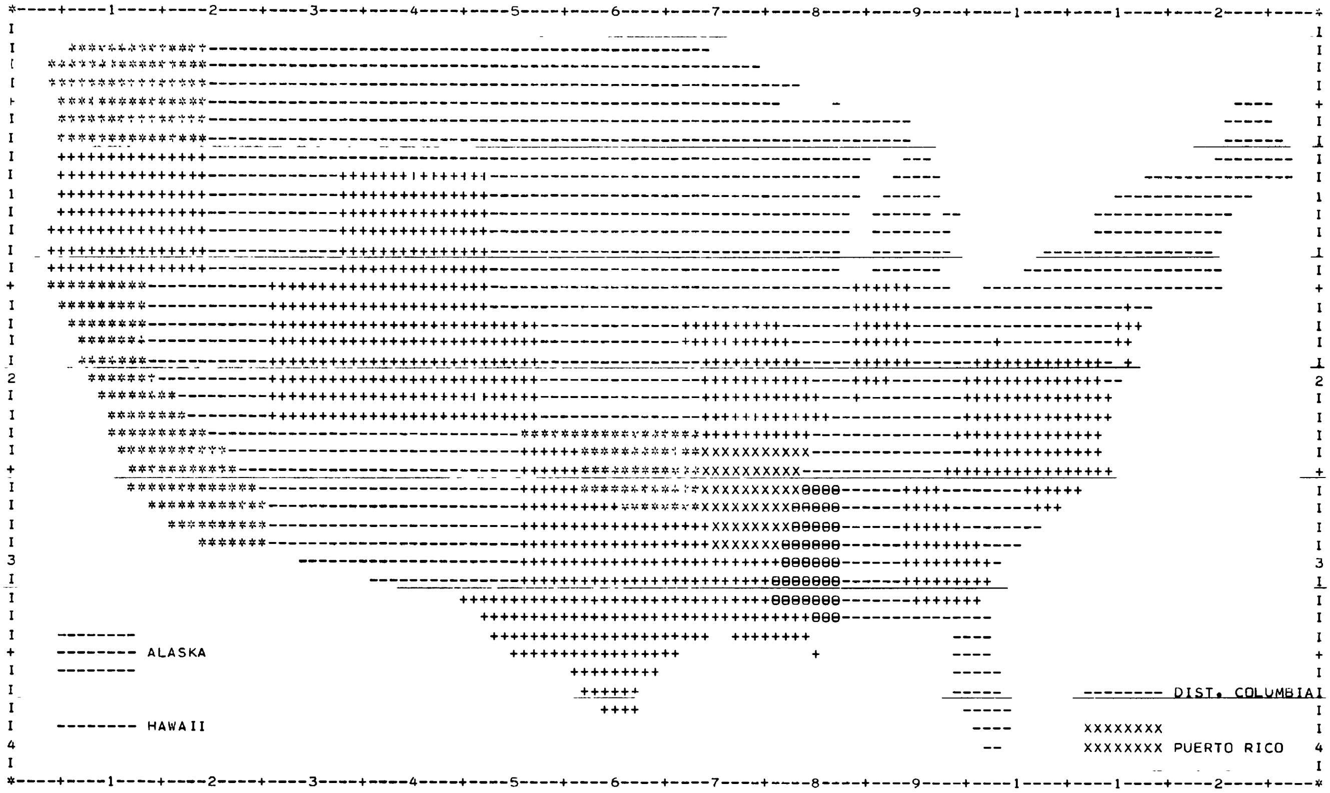
MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
  LEVEL         1         2         3         4         5         6         7
           ====================================================================
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 #########
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 #########
  SYMBOLS  ----1---- ++++2++++ ****3**** XXXX4XXXX 000050000 000060000 ####7####
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 #########
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 #########
           ====================================================================
  FREQ.        27        22         2         1         0         0         0
         1  I--1--I   I++2++I   I**3**I   IXX4XXI
         2  I--1--I   I++2++I   I**3**I
         3  I--1--I   I++2++I
         4  I--1--I   I++2++I
         5  I--1--I   I++2++I
         6  I--1--I   I++2++I
         7  I--1--I   I++2++I
         8  I--1--I   I++2++I
         9  I--1--I   I++2++I
        10  I--1--I   I++2++I
        11  I--1--I   I++2++I
        12  I--1--I   I++2++I
        13  I--1--I   I++2++I
        14  I--1--I   I++2++I
        15  I--1--I   I++2++I
        16  I--1--I   I++2++I
        17  I--1--I   I++2++I
        18  I--1--I   I++2++I
        19  I--1--I   I++2++I
        20  I--1--I   I++2++I
        21  I--1--I   I++2++I
        22  I--1--I   I++2++I
        23  I--1--I
        24  I--1--I
```



SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C TRAFFIC COURTS, FY68 THRU FY70 (HSP STANDARD 4.4.7)

DATA VALUE EXTREMES ARE 0.0 9.67

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

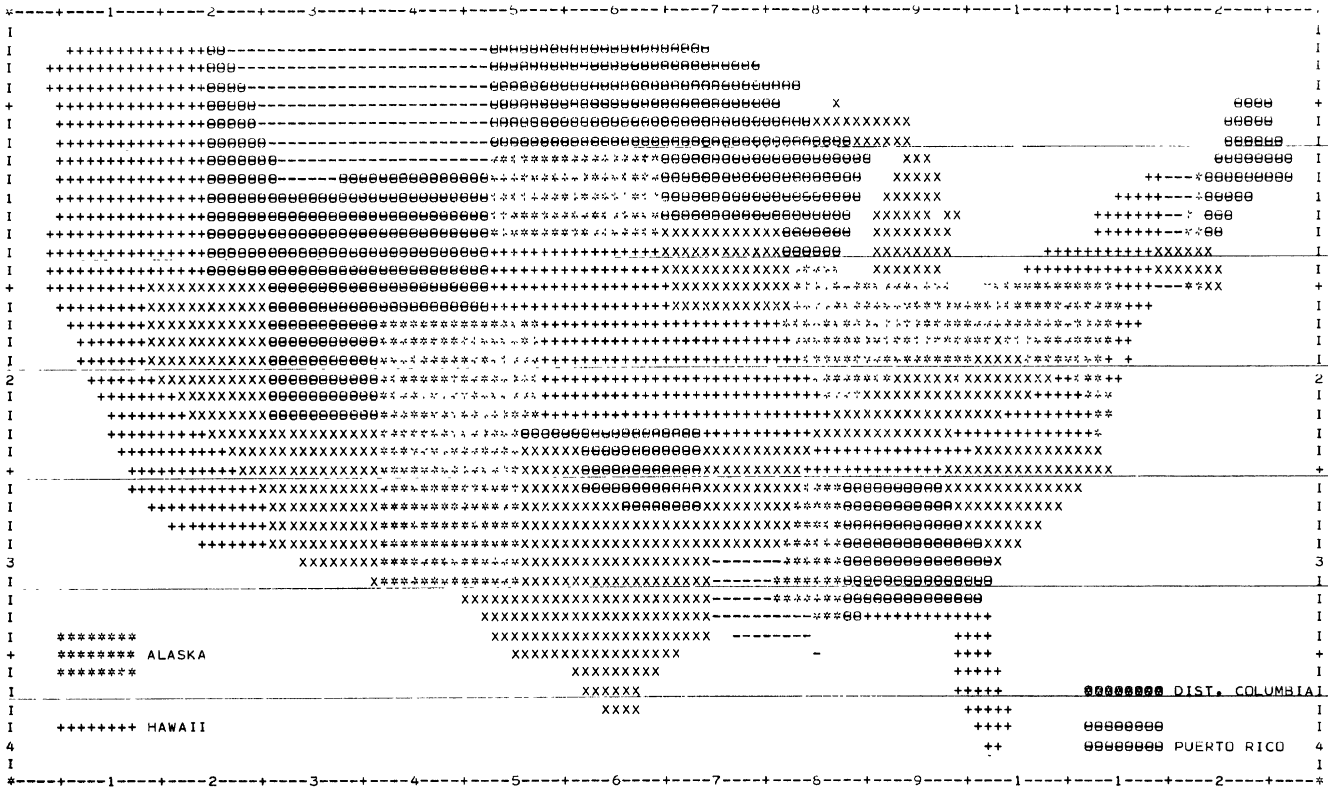
MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL        1         2         3         4         5         6         7
           =================================================================
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
 SYMBOLS   ----1---- ++++2++++ ****3**** XXXX4XXXX 000050000 000060000 ■■■■7■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           =================================================================
 FREQ.        32        14         3         2         1         0         0
         1 I--1--I   I++2++I   I**3**I   IXX4XXI   I00500I
         2 I--1--I   I++2++I   I**3**I   IXX4XXI
         3 I--1--I   I++2++I   I**3**I
         4 I--1--I   I++2++I
         5 I--1--I   I++2++I
         6 I--1--I   I++2++I
         7 I--1--I   I++2++I
         8 I--1--I   I++2++I
         9 I--1--I   I++2++I
        10 I--1--I   I++2++I
        11 I--1--I   I++2++I
        12 I--1--I   I++2++I
        13 I--1--I   I++2++I
        14 I--1--I   I++2++I
        15 I--1--I
        16 I--1--I
        17 I--1--I
        18 I--1--I
        19 I--1--I
        20 I--1--I
        21 I--1--I
        22 I--1--I
        23 I--1--I
        24 I--1--I
```



SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C ALCOHOL IN RELATION TO HIGHWAY SAFETY, FY68 THRU FY70

C (HSP STANDARD 4.4.8)

DATA VALUE EXTREMES ARE 0.0 16.75

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL       1          2          3          4          5          6          7
          =================================================================
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
 SYMBOLS  ----1----  ++++2++++  ****3****  XXXX4XXXX  0000500000  000060000  ■■■■7■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          =================================================================
 FREQ.       4          13         12         11         11         1          0
      1   I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I    I00600I
      2   I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I
      3   I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I
      4   I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I
      5              I++2++I    I**3**I    IXX4XXI    I00500I
      6              I++2++I    I**3**I    IXX4XXI    I00500I
      7              I++2++I    I**3**I    IXX4XXI    I00500I
      8              I++2++I    I**3**I    IXX4XXI    I00500I
      9              I++2++I    I**3**I    IXX4XXI    I00500I
     10              I++2++I    I**3**I    IXX4XXI    I00500I
     11              I++2++I    I**3**I    IXX4XXI    I00500I
     12              I++2++I    I**3**I
     13              I++2++I
```

TIME = 0.0

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C IDENTIFICATION AND SURVEILLANCE OF ACCIDENT LOCATIONS

C FY68 THRU FY70 (HSP STANDARD 4.4.9)

DATA VALUE EXTREMES ARE 0.0 14.15

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

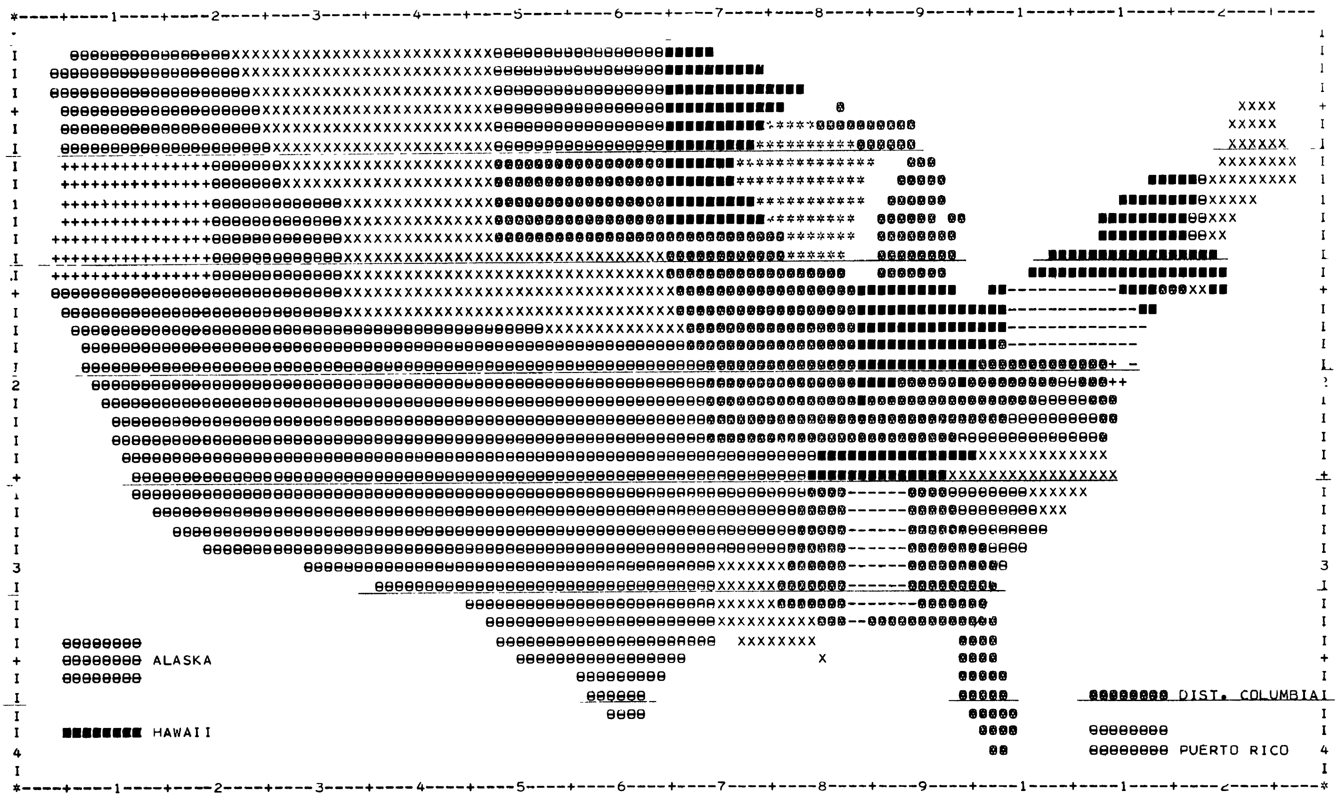
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7
	---------	+++++++++	*********	XXXXXXXXX	@@@@@@@@@	@@@@@@@@@	■■■■■■■■■
	---------	+++++++++	*********	XXXXXXXXX	@@@@@@@@@	@@@@@@@@@	■■■■■■■■■
SYMBOLS	----1----	++++2++++	****3****	XXXX4XXXX	@@@@5@@@@	@@@@6@@@@	■■■■7■■■■
	---------	+++++++++	*********	XXXXXXXXX	@@@@@@@@@	@@@@@@@@@	■■■■■■■■■
	---------	+++++++++	*********	XXXXXXXXX	@@@@@@@@@	@@@@@@@@@	■■■■■■■■■
FREQ.	17	14	8	8	5	0	0
1	I--1--I	I++2++I	I**3**I	IXX4XXI	I@@5@@I		
2	I--1--I	I++2++I	I**3**I	IXX4XXI	I@@5@@I		
3	I--1--I	I++2++I	I**3**I	IXX4XXI	I@@5@@I		
4	I--1--I	I++2++I	I**3**I	IXX4XXI	I@@5@@I		
5	I--1--I	I++2++I	I**3**I	IXX4XXI	I@@5@@I		
6	I--1--I	I++2++I	I**3**I	IXX4XXI			
7	I--1--I	I++2++I	I**3**I	IXX4XXI			
8	I--1--I	I++2++I	I**3**I	IXX4XXI			
9	I--1--I	I++2++I					
10	I--1--I	I++2++I					
11	I--1--I	I++2++I					
12	I--1--I	I++2++I					
13	I--1--I	I++2++I					
14	I--1--I	I++2++I					
15	I--1--I						
16	I--1--I						
17	I--1--I						

TIME = 0.0



SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C TRAFFIC RECORDS, FY68 THRU FY70 (HSP STANDARD 4.4.10)

DATA VALUE EXTREMES ARE 0.0 65.70

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

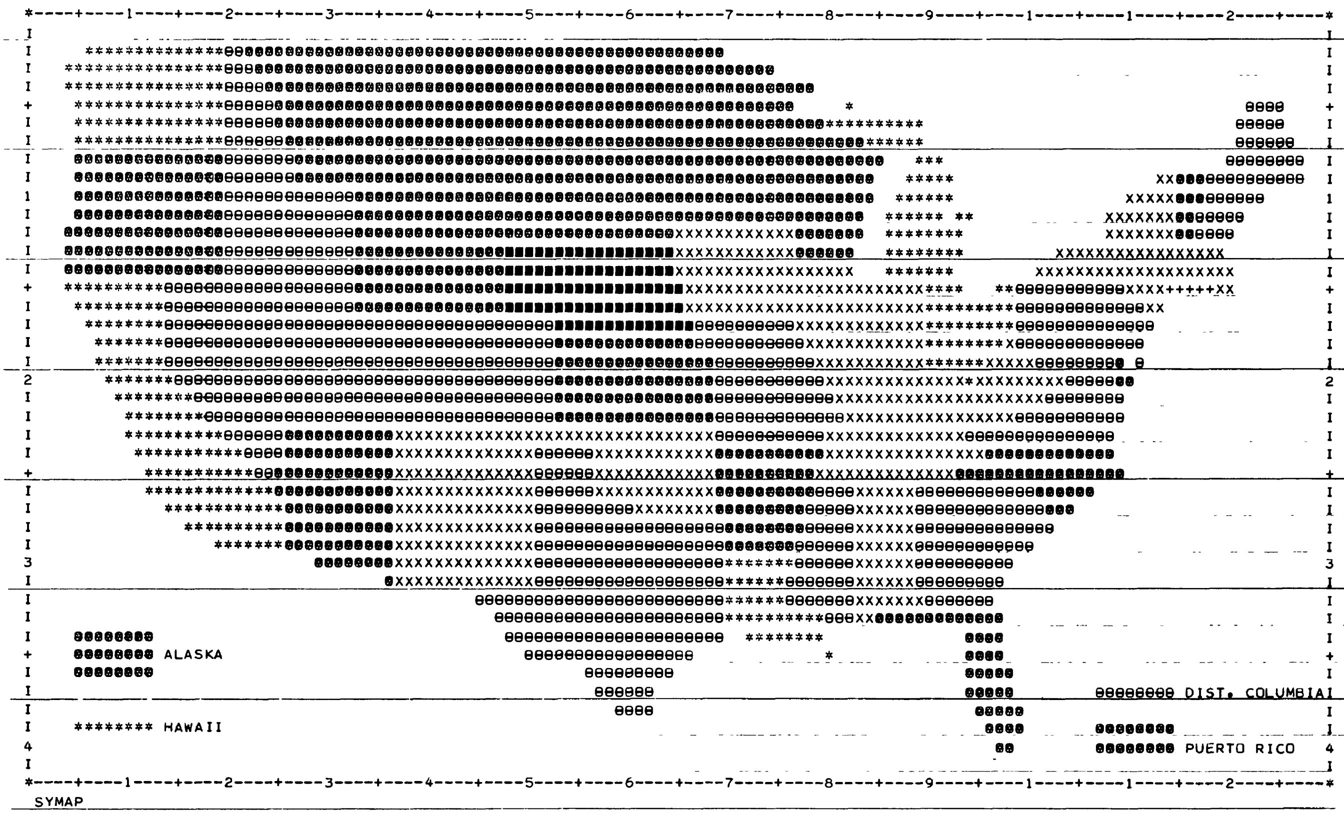
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
LEVEL        1          2          3          4          5          6          7
          ================================================================
          ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
SYMBOLS   ----1----  ++++2++++  ****3****  XXXX4XXXX  @@@@5@@@@  @@@@6@@@@  ■■■■7■■■■
          ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
          ================================================================
FREQ.        3          2          1          7          18         13         8
       1  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       2  I--1--I    I++2++I               IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       3  I--1--I                          IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       4                                   IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       5                                   IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       6                                   IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       7                                   IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
       8                                              I@@5@@I    I@@6@@I    I■■7■■I
       9                                              I@@5@@I    I@@6@@I
      10                                              I@@5@@I    I@@6@@I
      11                                              I@@5@@I    I@@6@@I
      12                                              I@@5@@I    I@@6@@I
      13                                              I@@5@@I    I@@6@@I
      14                                              I@@5@@I
      15                                              I@@5@@I
      16                                              I@@5@@I
      17                                              I@@5@@I
      18                                              I@@5@@I
```

TIME = 0.0



TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C EMERGENCY MEDICAL SERVICES, FY68 THRU FY70 (HSP STANDARD 4.4.11)

DATA VALUE EXTREMES ARE 0.65 44.33

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

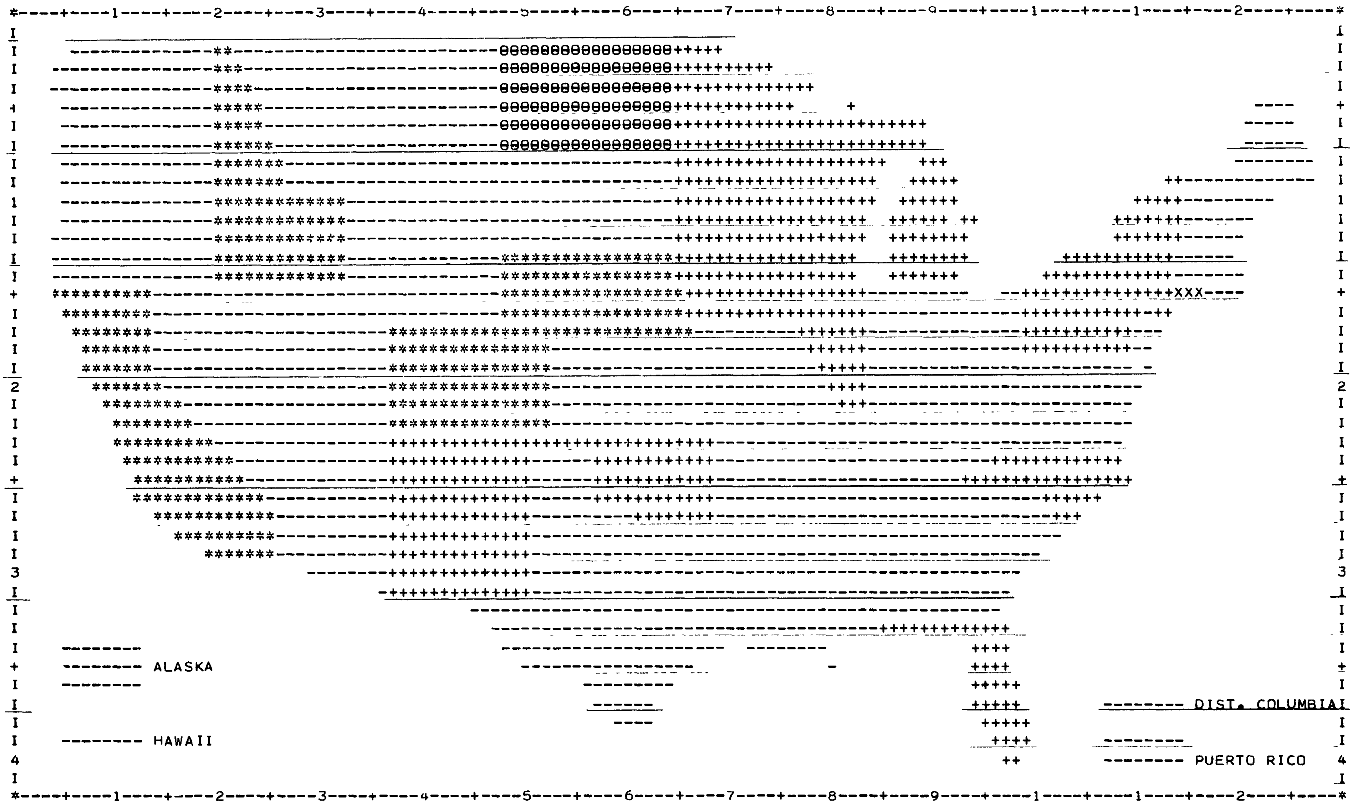
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL        1          2          3          4          5          6          7
           =================================================================
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
 SYMBOLS   ----1----  ++++2++++  ****3****  XXXX4XXXX  @@@@5@@@@  @@@@6@@@@  ■■■■7■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
           =================================================================
 FREQ.        0          2          6          11         16         16         1
      1               I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I    I■■7■■I
      2               I++2++I    I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
      3                          I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
      4                          I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
      5                          I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
      6                          I**3**I    IXX4XXI    I@@5@@I    I@@6@@I
      7                                     IXX4XXI    I@@5@@I    I@@6@@I
      8                                     IXX4XXI    I@@5@@I    I@@6@@I
      9                                     IXX4XXI    I@@5@@I    I@@6@@I
     10                                     IXX4XXI    I@@5@@I    I@@6@@I
     11                                     IXX4XXI    I@@5@@I    I@@6@@I
     12                                                I@@5@@I    I@@6@@I
     13                                                I@@5@@I    I@@6@@I
     14                                                I@@5@@I    I@@6@@I
     15                                                I@@5@@I    I@@6@@I
     16                                                I@@5@@I    I@@6@@I
```

TIME = 0.0



SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C HIGHWAY DESIGN, CONSTRUCTION AND MAINTENANCE, FY68 THRU FY70

C (HSP STANDARD 4.4.12)

DATA VALUE EXTREMES ARE 0.0 10.86

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
LEVEL        1         2         3         4         5         6         7
         ======================================================================
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
SYMBOLS   ----1---- ++++2++++ ****3**** XXXX4XXXX 0000500000 000060000 ■■■■7■■■■
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
          --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
         ======================================================================
FREQ.       35        11         4         1         1         0         0
      1  I--1--I   I++2++I   I**3**I   IXX4XXI   I00500I
      2  I--1--I   I++2++I   I**3**I
      3  I--1--I   I++2++I   I**3**I
      4  I--1--I   I++2++I   I**3**I
      5  I--1--I   I++2++I
      6  I--1--I   I++2++I
      7  I--1--I   I++2++I
      8  I--1--I   I++2++I
      9  I--1--I   I++2++I
     10  I--1--I   I++2++I
     11  I--1--I   I++2++I
     12  I--1--I
     13  I--1--I
     14  I--1--I
     15  I--1--I
     16  I--1--I
     17  I--1--I
     18  I--1--I
     19  I--1--I
     20  I--1--I
     21  I--1--I
     22  I--1--I
     23  I--1--I
     24  I--1--I
```

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C TRAFFIC CONTROL DEVICES, FY68 THRU FY70 (HSP STANDARD 4.4.13)

DATA VALUE EXTREMES ARE 0.0 15.10

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

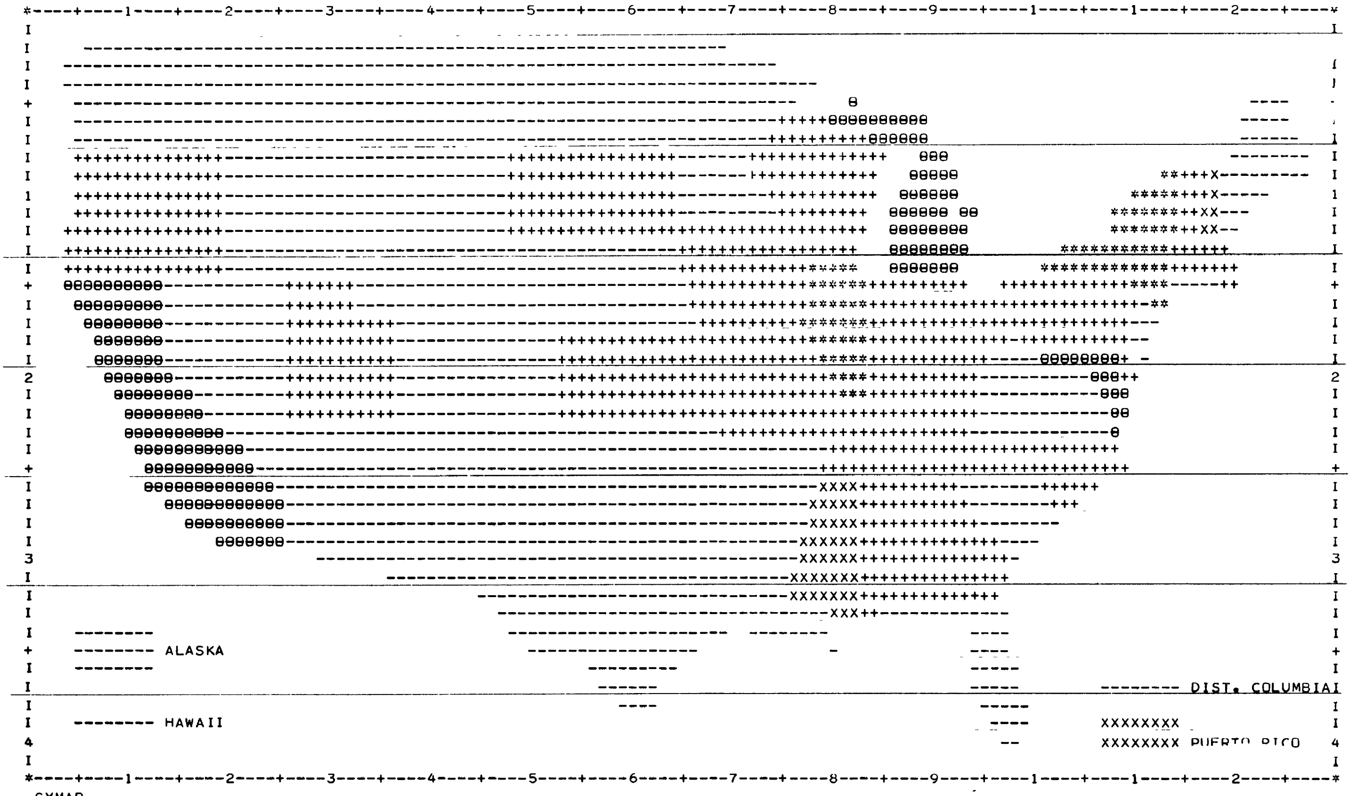
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL        1          2          3          4          5          6          7
          ===================================================================
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
 SYMBOLS  ----1----  ++++2++++  ****3****  XXXX4XXXX  00005000  000060000  ■■■■7■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          ---------  +++++++++  *********  XXXXXXXXX  000000000  000000000  ■■■■■■■■■
          ===================================================================
 FREQ.       18         22          2          8          2          0          0
       1  I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I
       2  I--1--I    I++2++I    I**3**I    IXX4XXI    I00500I
       3  I--1--I    I++2++I               IXX4XXI
       4  I--1--I    I++2++I               IXX4XXI
       5  I--1--I    I++2++I               IXX4XXI
       6  I--1--I    I++2++I               IXX4XXI
       7  I--1--I    I++2++I               IXX4XXI
       8  I--1--I    I++2++I               IXX4XXI
       9  I--1--I    I++2++I
      10  I--1--I    I++2++I
      11  I--1--I    I++2++I
      12  I--1--I    I++2++I
      13  I--1--I    I++2++I
      14  I--1--I    I++2++I
      15  I--1--I    I++2++I
      16  I--1--I    I++2++I
      17  I--1--I    I++2++I
      18  I--1--I    I++2++I
      19             I++2++I
      20             I++2++I
      21             I++2++I
      22             I++2++I
```


TIME = 0.0



SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C PEDESTRIAN SAFETY, FY68 THRU FY70 (HSP STANDARD 4.4.14)

DATA VALUE EXTREMES ARE 0.0 12.90

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

```
 LEVEL        1         2         3         4         5         6         7
           =================================================================
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
 SYMBOLS   ----1---- ++++2++++ ****3**** XXXX4XXXX 000050000 000060000 ■■■■7■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           --------- +++++++++ ********* XXXXXXXXX 000000000 000000000 ■■■■■■■■■
           =================================================================
 FREQ.       26        18         2         3         3         0         0
        1  I--1--I   I++2++I   I**3**I   IXX4XXI   I005001
        2  I--1--I   I++2++I   I**3**I   IXX4XXI   I005001
        3  I--1--I   I++2++I             IXX4XXI   I005001
        4  I--1--I   I++2++I
        5  I--1--I   I++2++I
        6  I--1--I   I++2++I
        7  I--1--I   I++2++I
        8  I--1--I   I++2++I
        9  I--1--I   I++2++I
       10  I--1--I   I++2++I
       11  I--1--I   I++2++I
       12  I--1--I   I++2++I
       13  I--1--I   I++2++I
       14  I--1--I   I++2++I
       15  I--1--I   I++2++I
       16  I--1--I   I++2++I
       17  I--1--I   I++2++I
       18  I--1--I   I++2++I
       19  I--1--I
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       22  I--1--I
       23  I--1--I
       24  I--1--I
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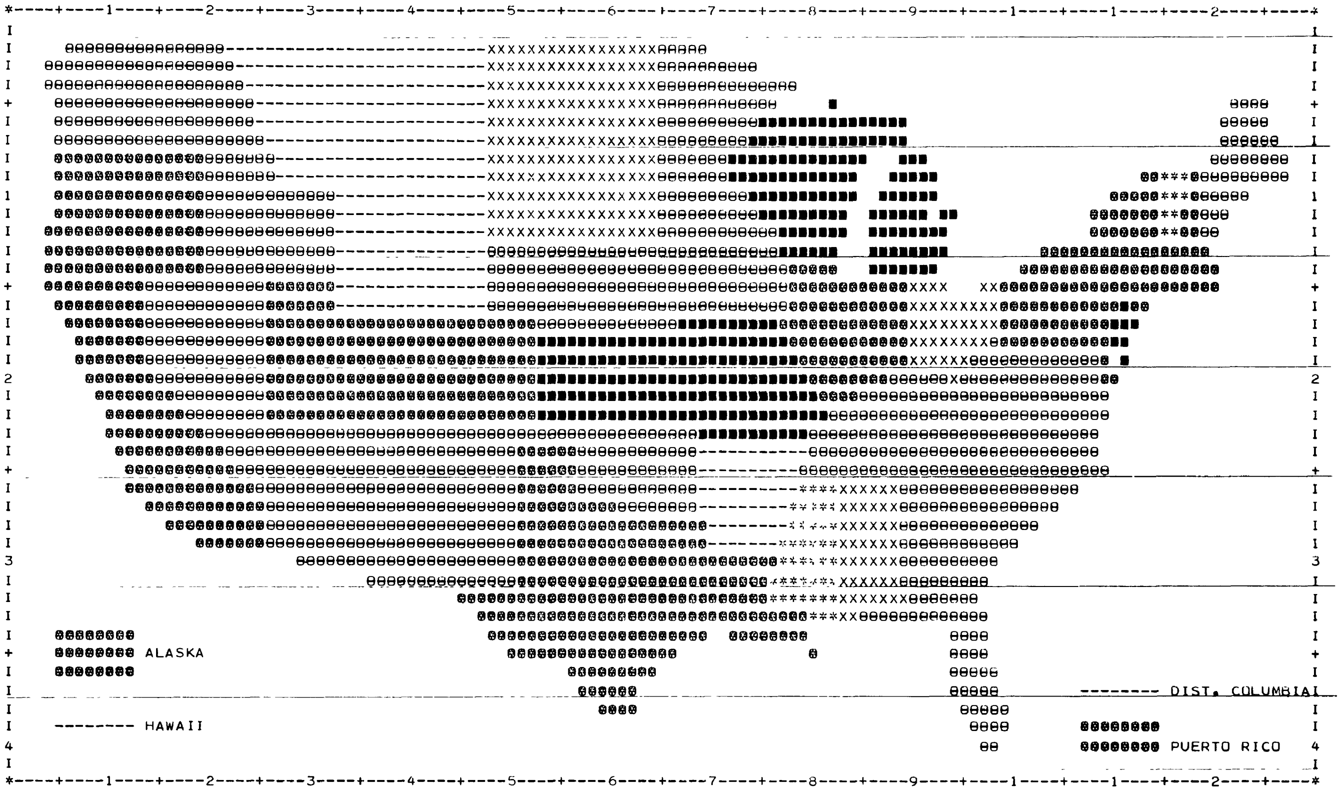

SYMAP

TIME = 0.0

C PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C POLICE TRAFFIC SERVICES, FY68 THRU FY70 (HSP STANDARD 4.4.15)

DATA VALUE EXTREMES ARE 0.0 46.57

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	2.00	4.00	8.00	16.00	32.00
MAXIMUM	0.01	2.00	4.00	8.00	16.00	32.00	100.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

0.01	1.99	2.00	4.00	8.00	16.00	68.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7
	---------	+++++++++	*********	XXXXXXXXX	θθθθθθθθθ	ΘΘΘΘΘΘΘΘΘ	■■■■■■■■■
	---------	+++++++++	*********	XXXXXXXXX	θθθθθθθθθ	ΘΘΘΘΘΘΘΘΘ	■■■■■■■■■
SYMBOLS	----1----	++++2++++	****3****	XXXX4XXXX	θθθθ5θθθθ	ΘΘΘΘ6ΘΘΘΘ	■■■■7■■■■
	---------	+++++++++	*********	XXXXXXXXX	θθθθθθθθθ	ΘΘΘΘΘΘΘΘΘ	■■■■■■■■■
	---------	+++++++++	*********	XXXXXXXXX	θθθθθθθθθ	ΘΘΘΘΘΘΘΘΘ	■■■■■■■■■
FREQ.	5	0	2	4	19	17	5
1	I--1--I		I**3**I	IXX4XXI	Iθθ5θθI	IΘΘ6ΘΘI	I■■7■■I
2	I--1--I		I**3**I	IXX4XXI	Iθθ5θθI	IΘΘ6ΘΘI	I■■7■■I
3	I--1--I			IXX4XXI	Iθθ5θθI	IΘΘ6ΘΘI	I■■7■■I
4	I--1--I			IXX4XXI	Iθθ5θθI	IΘΘ6ΘΘI	I■■7■■I
5	I--1--I				Iθθ5θθI	IΘΘ6ΘΘI	I■■7■■I
6					Iθθ5θθI	IΘΘ6ΘΘI	
7					Iθθ5θθI	IΘΘ6ΘΘI	
8					Iθθ5θθI	IΘΘ6ΘΘI	
9					Iθθ5θθI	IΘΘ6ΘΘI	
10					Iθθ5θθI	IΘΘ6ΘΘI	
11					Iθθ5θθI	IΘΘ6ΘΘI	
12					Iθθ5θθI	IΘΘ6ΘΘI	
13					Iθθ5θθI	IΘΘ6ΘΘI	
14					Iθθ5θθI	IΘΘ6ΘΘI	
15					Iθθ5θθI	IΘΘ6ΘΘI	
16					Iθθ5θθI	IΘΘ6ΘΘI	
17					Iθθ5θθI	IΘΘ6ΘΘI	
18					Iθθ5θθI		
19					Iθθ5θθI		

TIME = 0.0


```
SYMAP

TIME =     0.0


C   PERCENTAGE OF EACH STATE'S TOTAL AUTHORIZED FEDERAL "402" FUNDS FOR

C   DEBRIS HAZARD CONTROL AND CLEANUP, FY68 THRU FY70,

C   (HSP STANDARD 4.4.16)


DATA VALUE EXTREMES ARE          0.0          13.53


ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
       ('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)


  MINIMUM       0.0        0.01       2.00       4.00       8.00      16.00      32.00
  MAXIMUM       0.01       2.00       4.00       8.00      16.00      32.00     100.00


PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL


                0.01       1.99       2.00       4.00       8.00      16.00      68.00


FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL
  LEVEL         1          2          3          4          5          6          7
          ===============================================================================
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
  SYMBOLS  ----1----  ++++2++++  ****3****  XXXX4XXXX  @@@@5@@@@  @@@@6@@@@  ■■■■7■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
           ---------  +++++++++  *********  XXXXXXXXX  @@@@@@@@@  @@@@@@@@@  ■■■■■■■■■
          ===============================================================================
  FREQ.        42          6          2          1          1          0          0
          1  I--1--I    I++2++I    I**3**I    IXX4XXI    I@@5@@I
          2  I--1--I    I++2++I    I**3**I
          3  I--1--I    I++2++I
          4  I--1--I    I++2++I
          5  I--1--I    I++2++I
          6  I--1--I    I++2++I
          7  I--1--I
          8  I--1--I
          9  I--1--I
         10  I--1--I
         11  I--1--I
         12  I--1--I
         13  I--1--I
         14  I--1--I
         15  I--1--I
         16  I--1--I
         17  I--1--I
         18  I--1--I
         19  I--1--I
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         21  I--1--I
         22  I--1--I
         23  I--1--I
         24  I--1--I
```
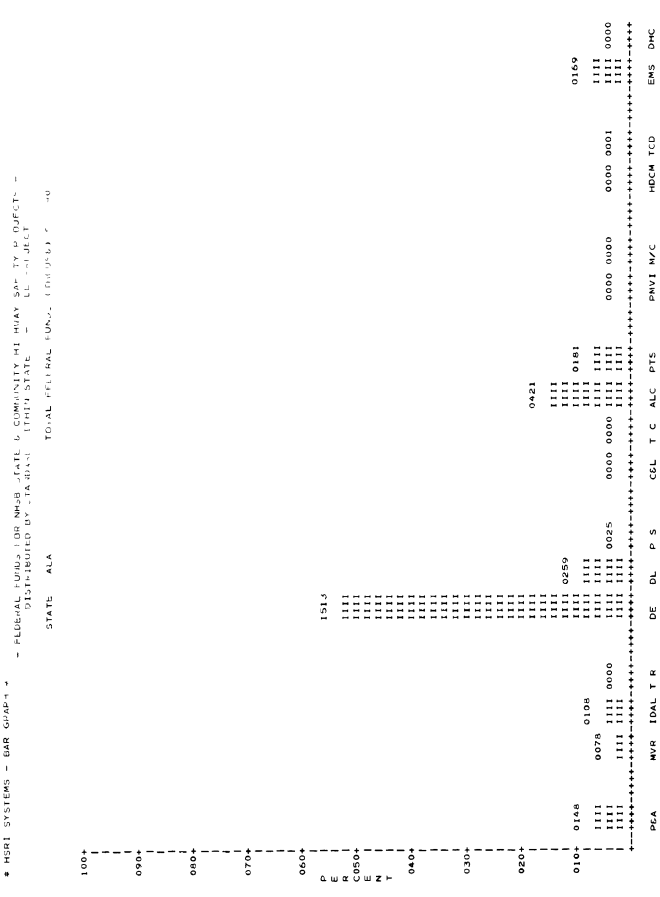
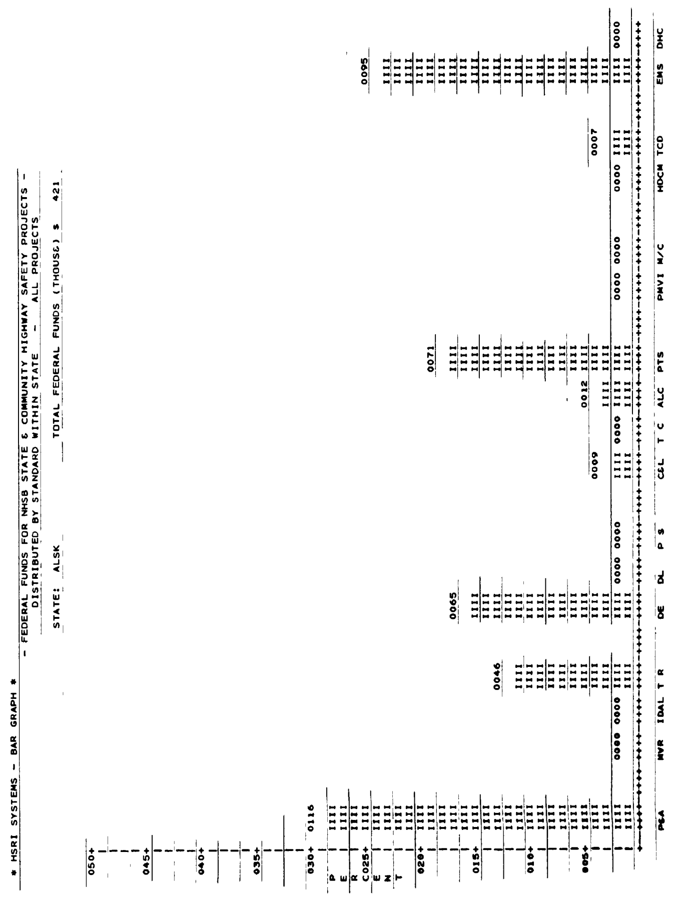
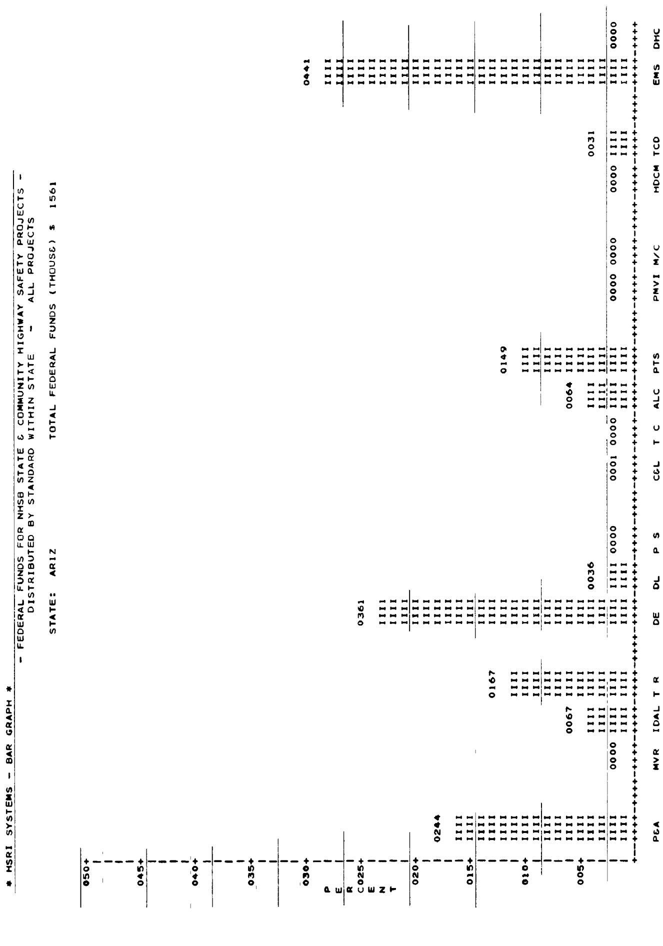



PGA MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC



* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: ALSK
TOTAL FEDERAL FUNDS (THOUSE) $ 421
PGA MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC



* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: ARIZ
TOTAL FEDERAL FUNDS (THOUSE) $ 1561
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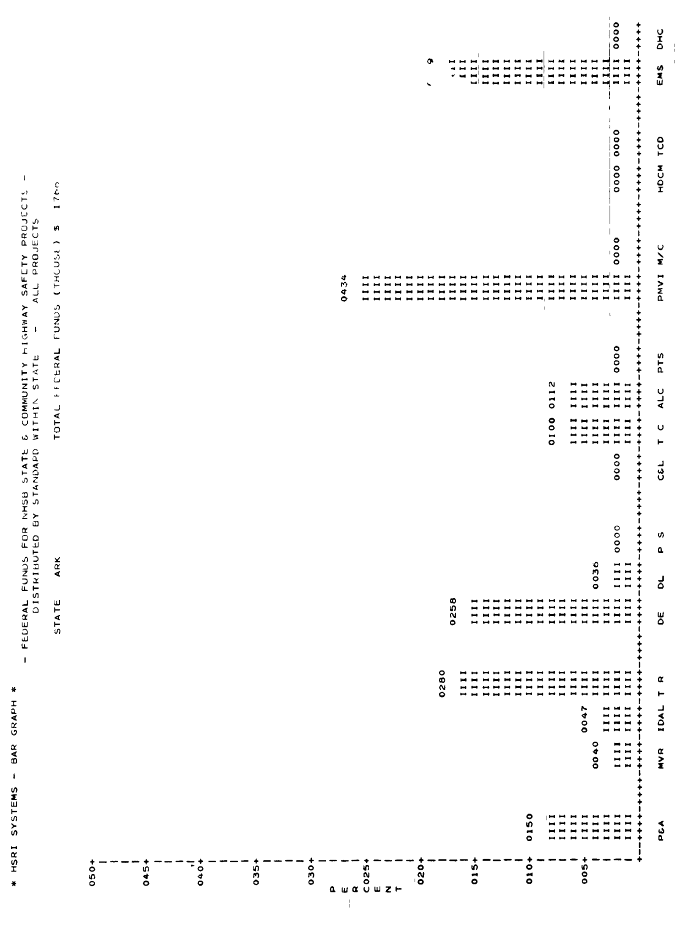
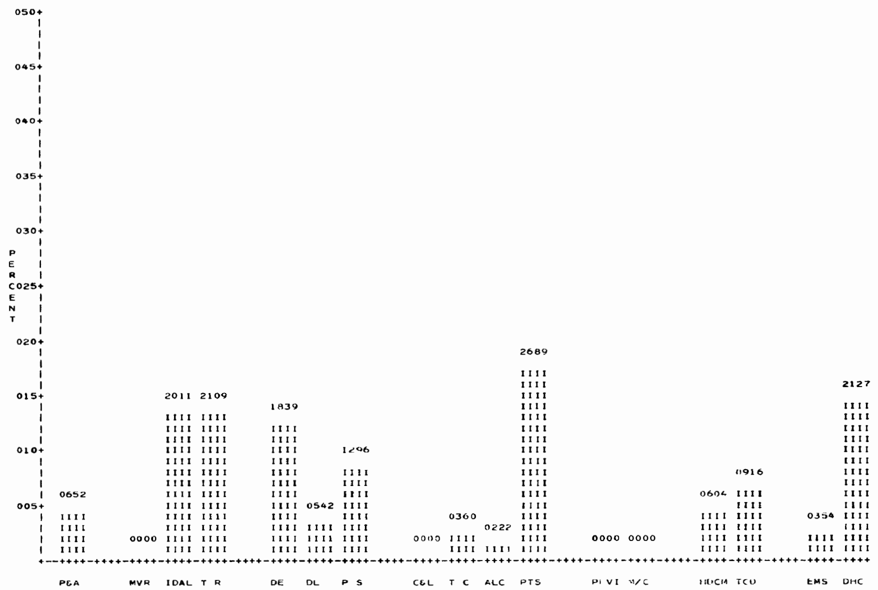


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE ARK
PGA MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

* HSRI SYSTEMS - BAR GRAPH *

– FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS –
DISTRIBUTED BY STANDARD WITHIN STATE – ALL PROJECTS

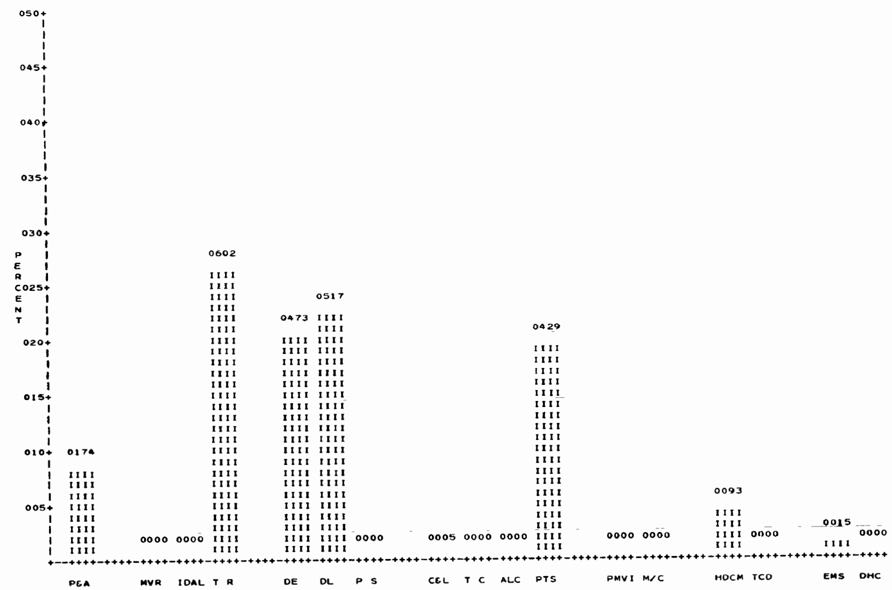
STATE CAL TOTAL FEDERAL FUNDS (THOUS$) $ 15721



* HSRI SYSTEMS - BAR GRAPH *

– FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS –
DISTRIBUTED BY STANDARD WITHIN STATE – ALL PROJECTS

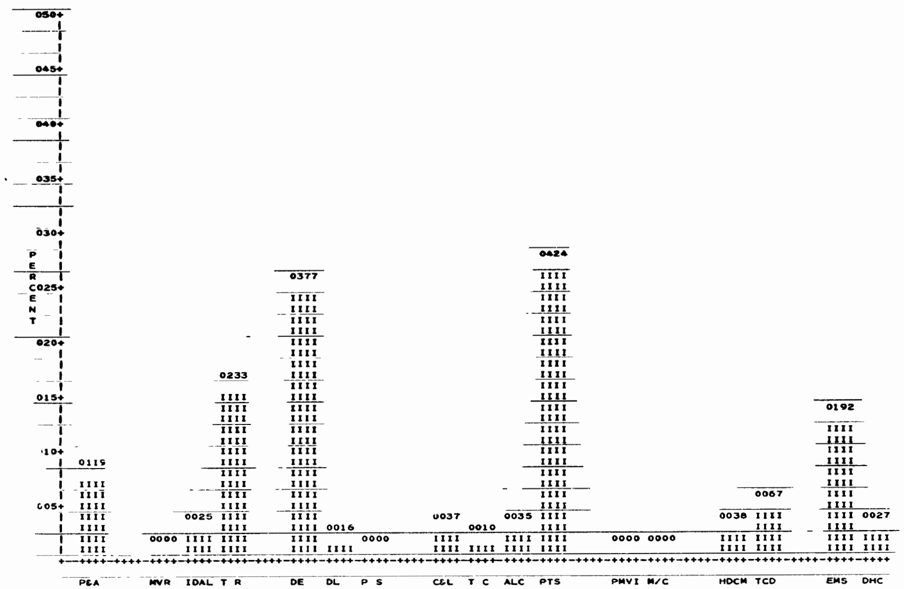
STATE CONN TOTAL FEDERAL FUNDS (THOUS$) $ 2308



* HSRI SYSTEMS - BAR GRAPH *

– FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS –
DISTRIBUTED BY STANDARD WITHIN STATE – ALL PROJECTS

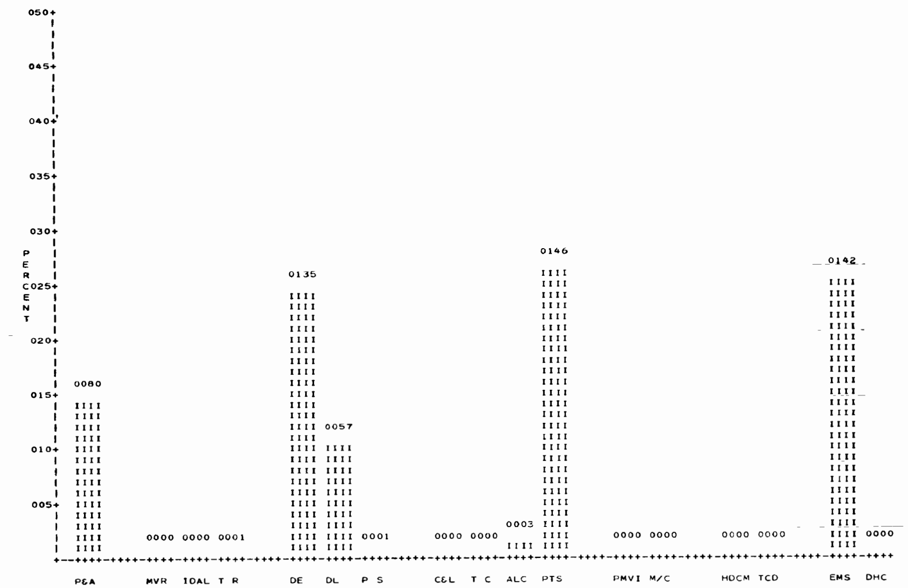
STATE: COLO TOTAL FEDERAL FUNDS (THOUS$) $ 1600

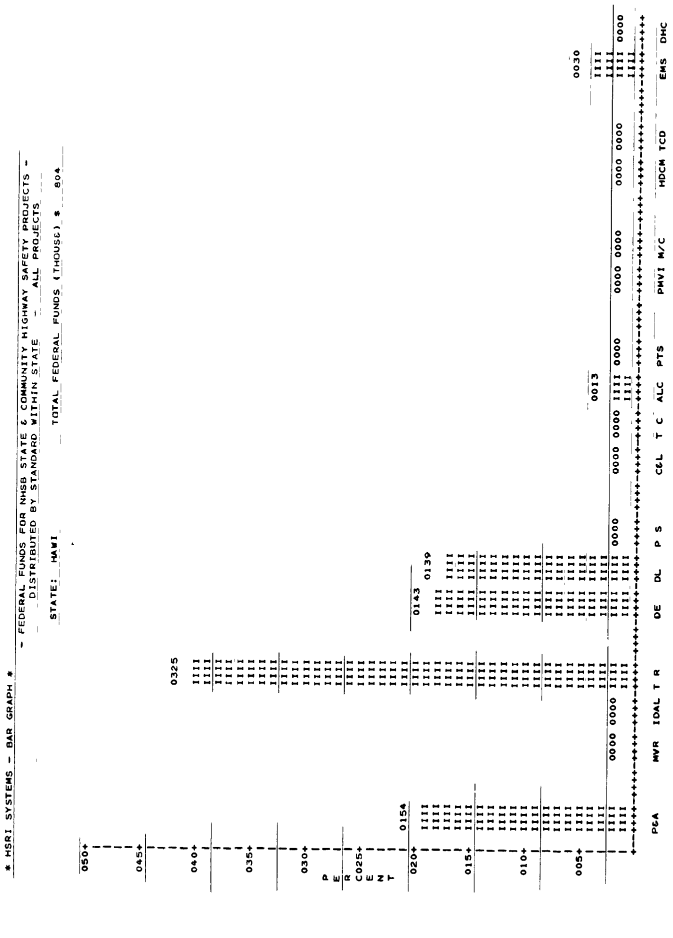


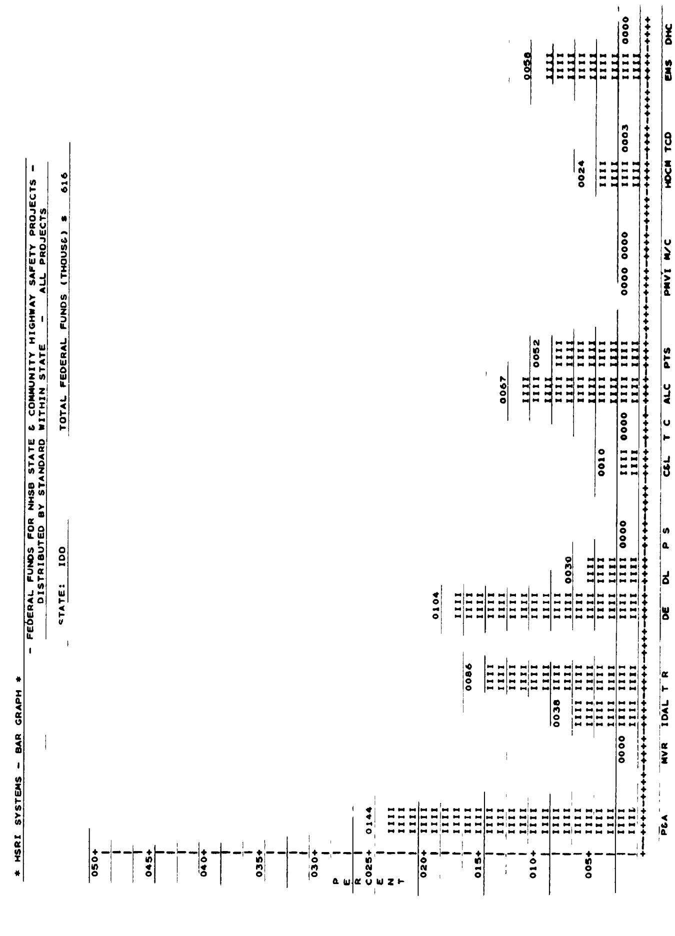
* HSRI SYSTEMS - BAR GRAPH *

– FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS –
DISTRIBUTED BY STANDARD WITHIN STATE – ALL PROJECTS

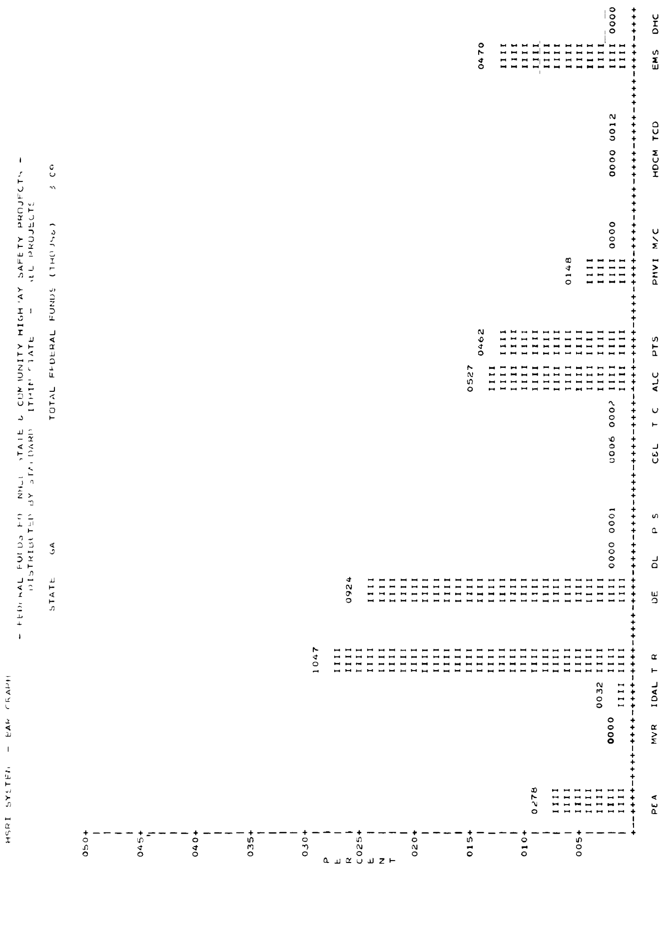
STATE DEL TOTAL FEDERAL FUNDS (THOUS$) 56




* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: HAWI
TOTAL FEDERAL FUNDS (THOUS&) $ 804


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: IDO
TOTAL FEDERAL FUNDS (THOUS&) $ 616

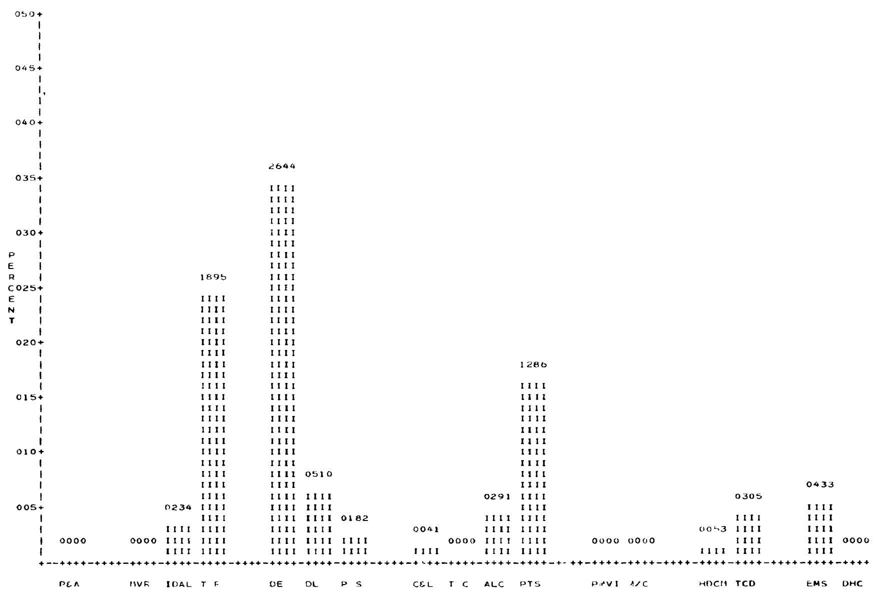

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE FLA
TOTAL FEDERAL FUNDS (THOUS&) $ 4810


STATE GA

[illegible]

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

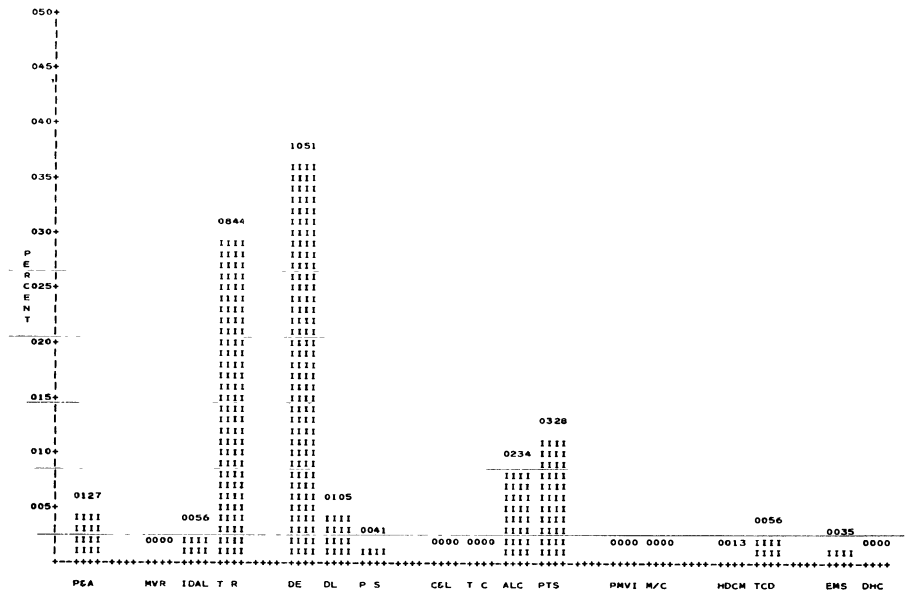
STATE. IL TOTAL FEDERAL FUNDS (THOUS&) $ [illegible]



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

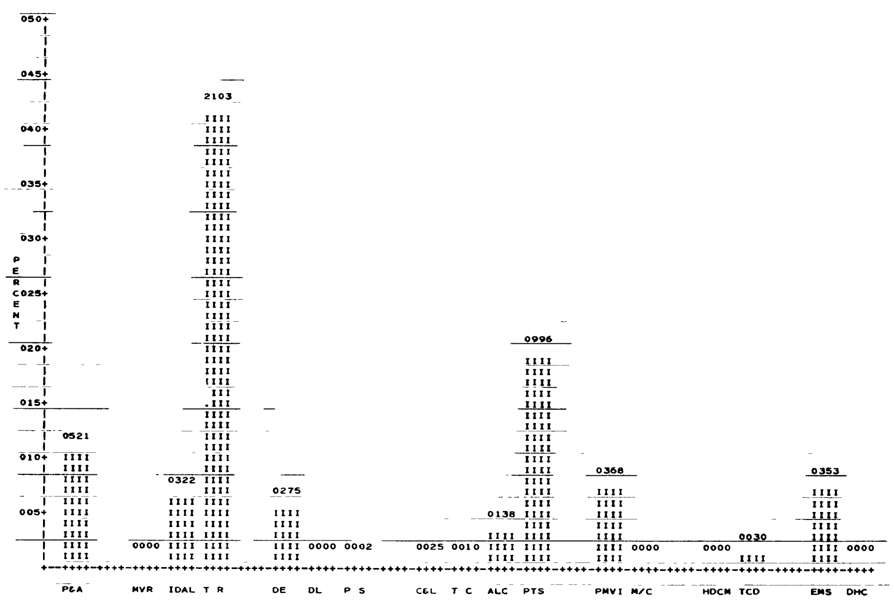
STATE. IOWA TOTAL FEDERAL FUNDS (THOUS&) $ 2890



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

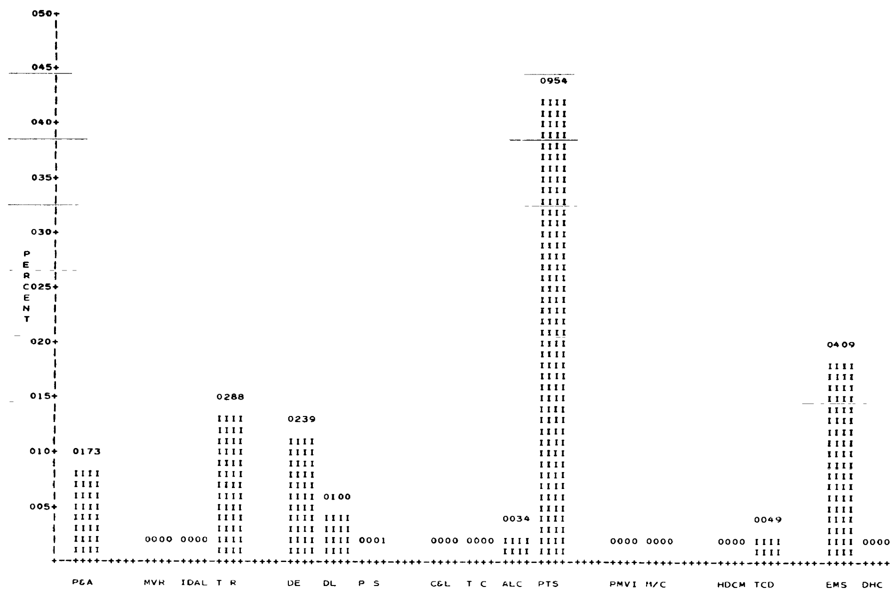
STATE: IND TOTAL FEDERAL FUNDS (THOUS&) $ 5143

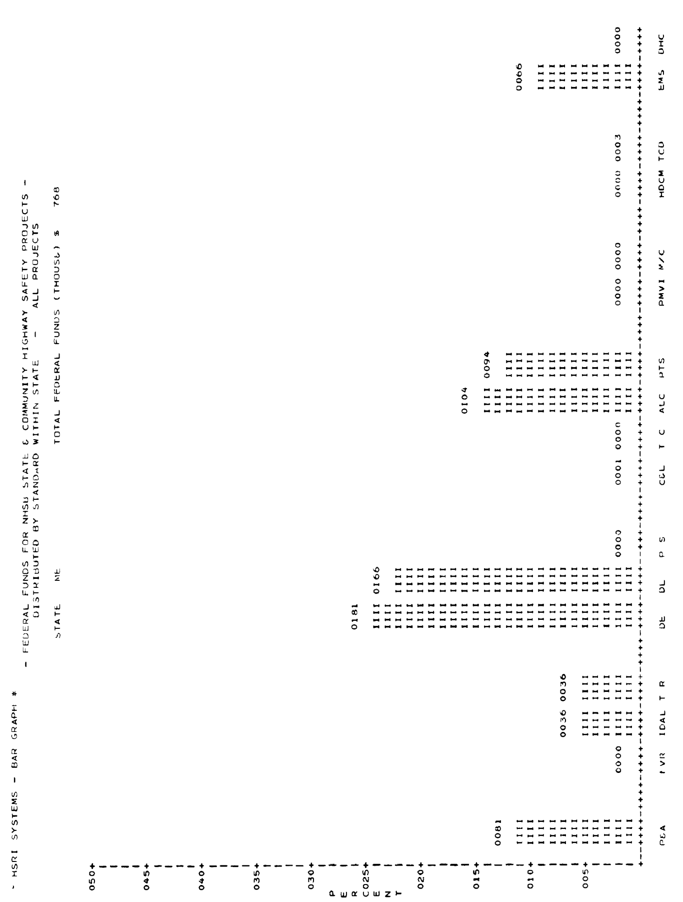


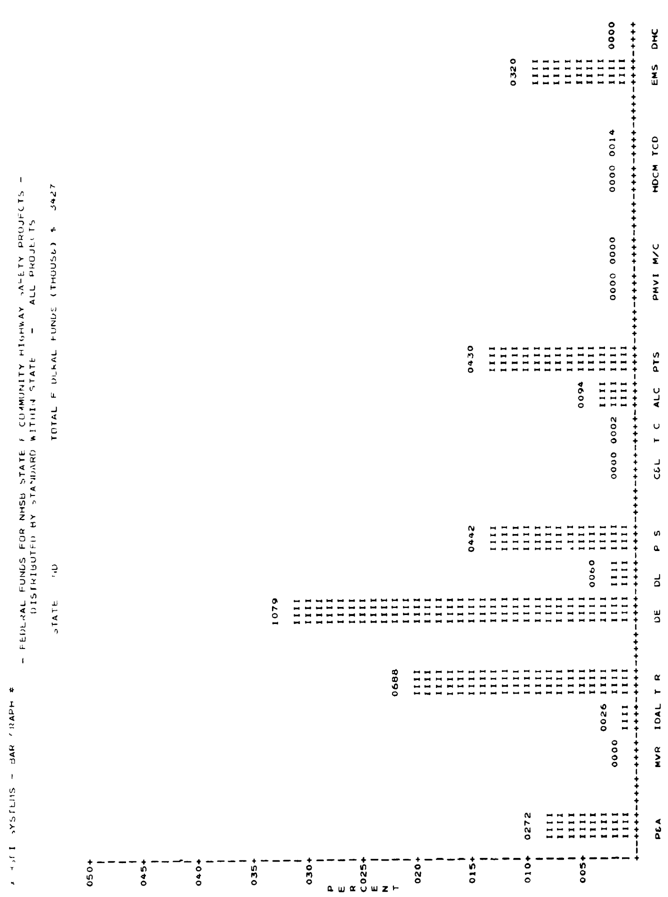
* HSRI SYSTEMS - BAR GRAPH *

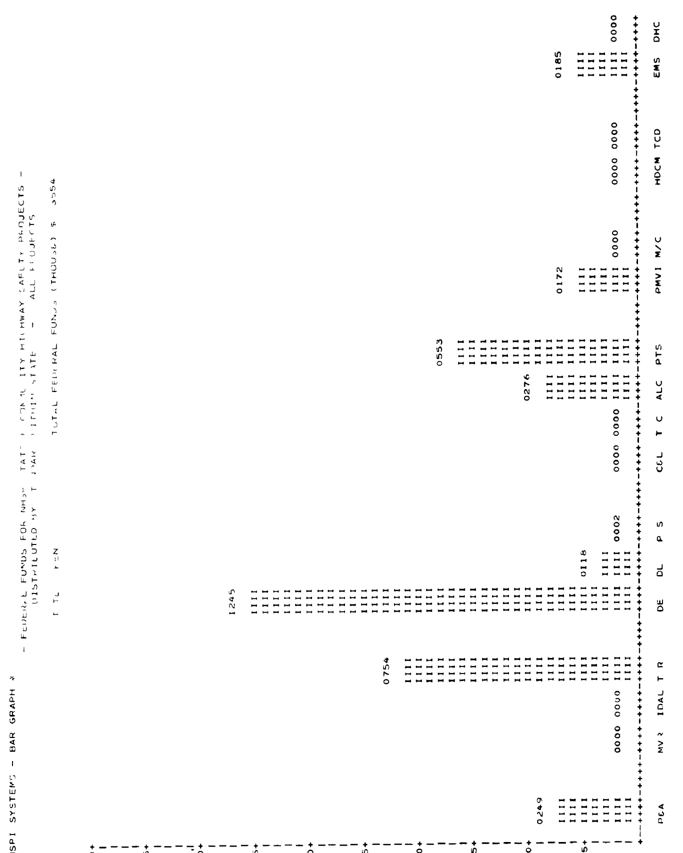
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

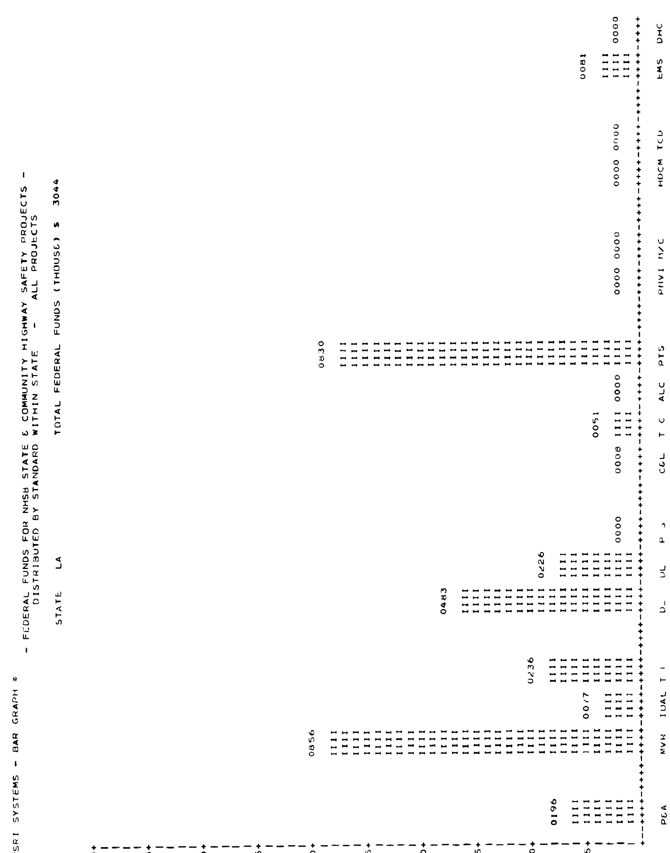
STATE. KAN TOTAL FEDERAL FUNDS (THOUS&) $ 2247




HSRI SYSTEMS - BAR GRAPH
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE ME
TOTAL FEDERAL FUNDS (THOUSE) $ 768


- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
TOTAL FEDERAL FUNDS (THOUSE) $ 3927

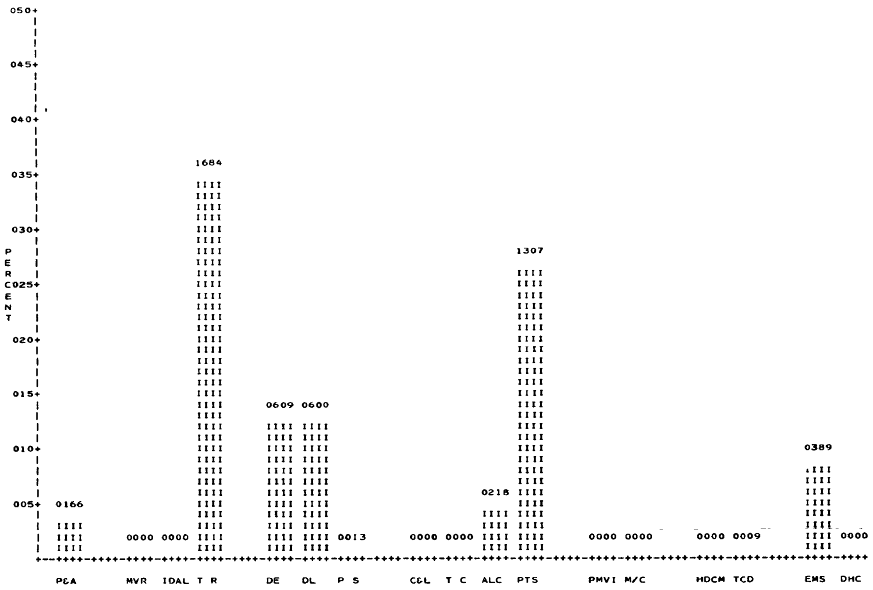

HSRI SYSTEMS - BAR GRAPH
TOTAL FEDERAL FUNDS (THOUSE) $ 3554


HSRI SYSTEMS - BAR GRAPH
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE LA
TOTAL FEDERAL FUNDS (THOUSE) $ 3044

* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

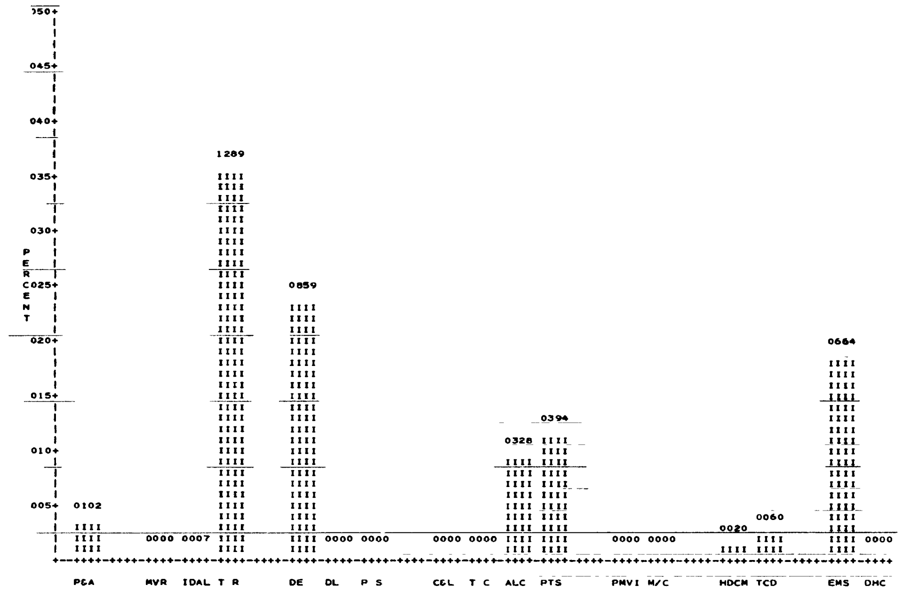
STATE MASS TOTAL FEDERAL FUNDS (THOUS$) $ 4995



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

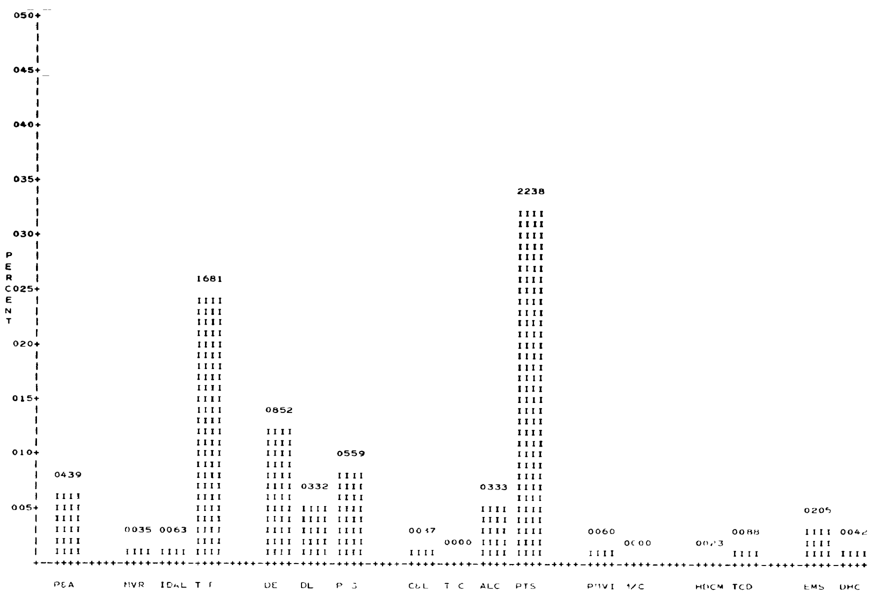
STATE: MINN TOTAL FEDERAL FUNDS (THOUS$) $ 3723



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

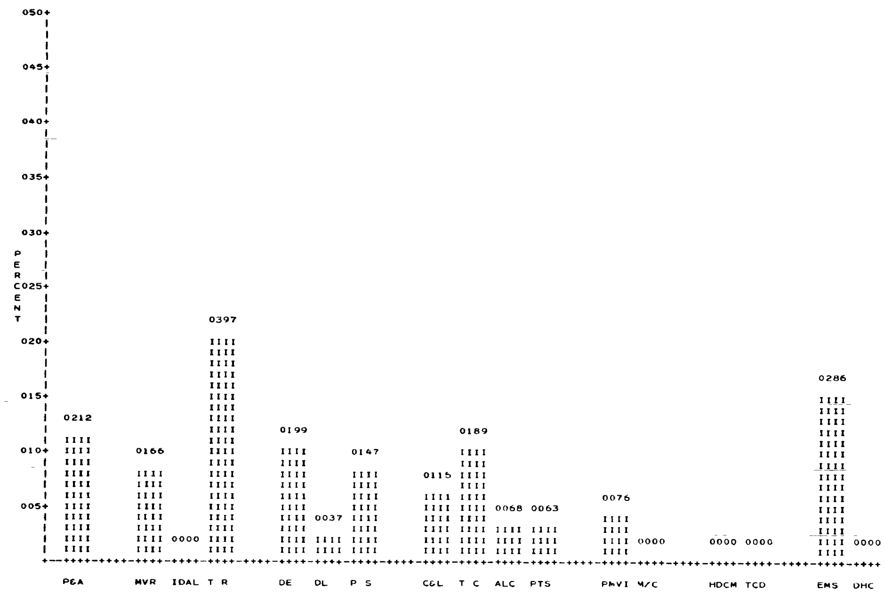
STATE. MICH TOTAL FEDERAL FUNDS (THOUS$) $ 6987

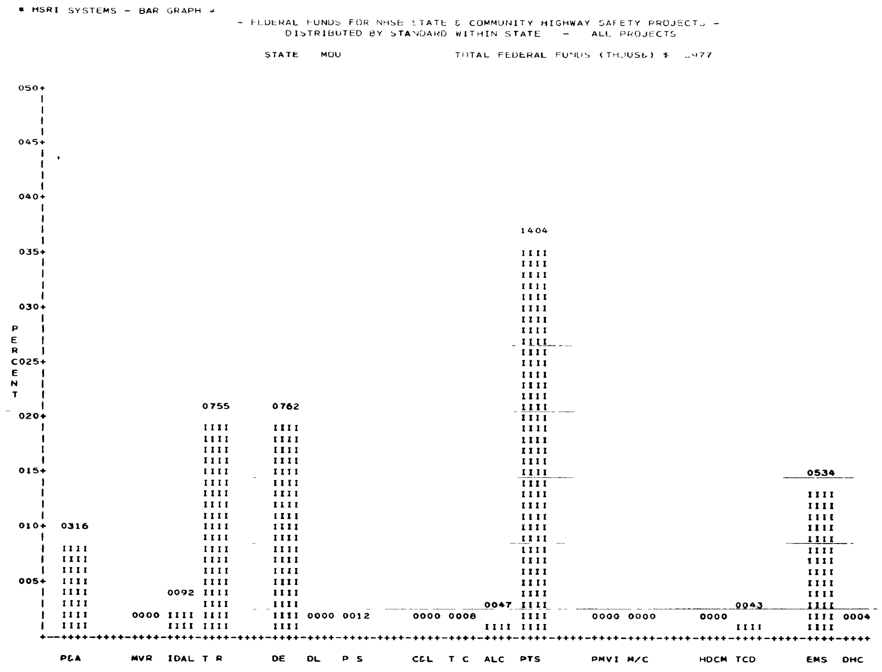


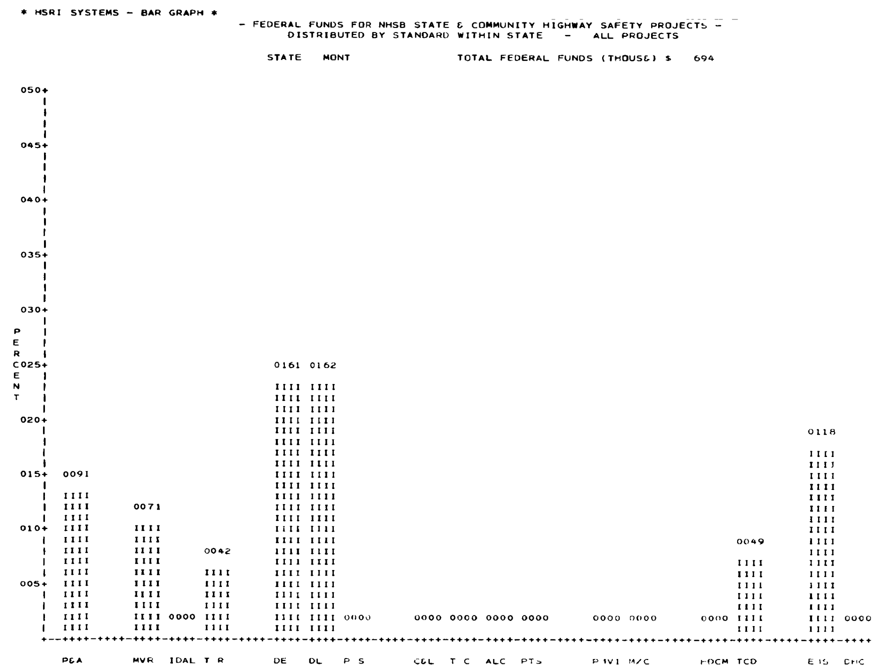
* HSRI SYSTEMS - BAR GRAPH *

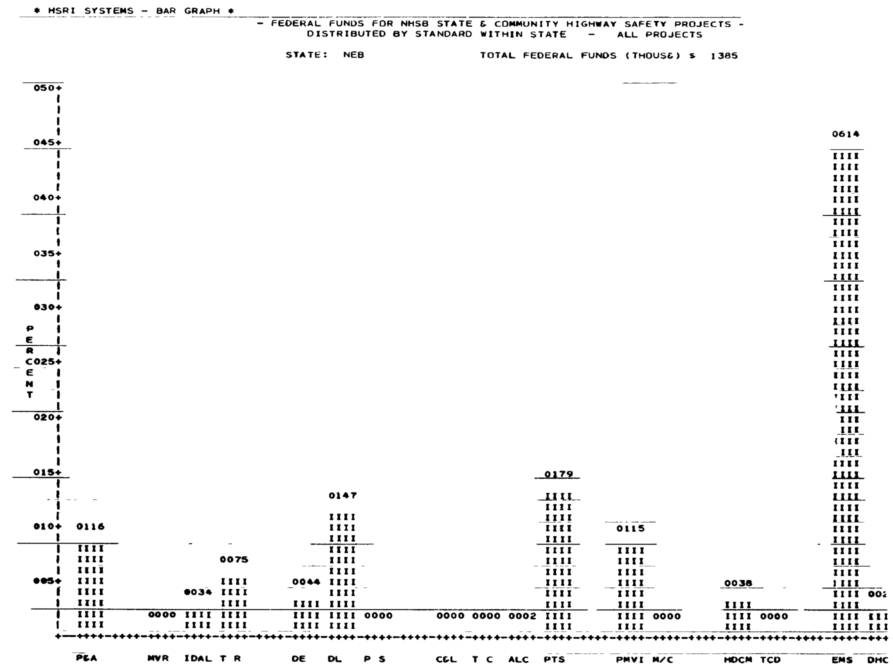
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

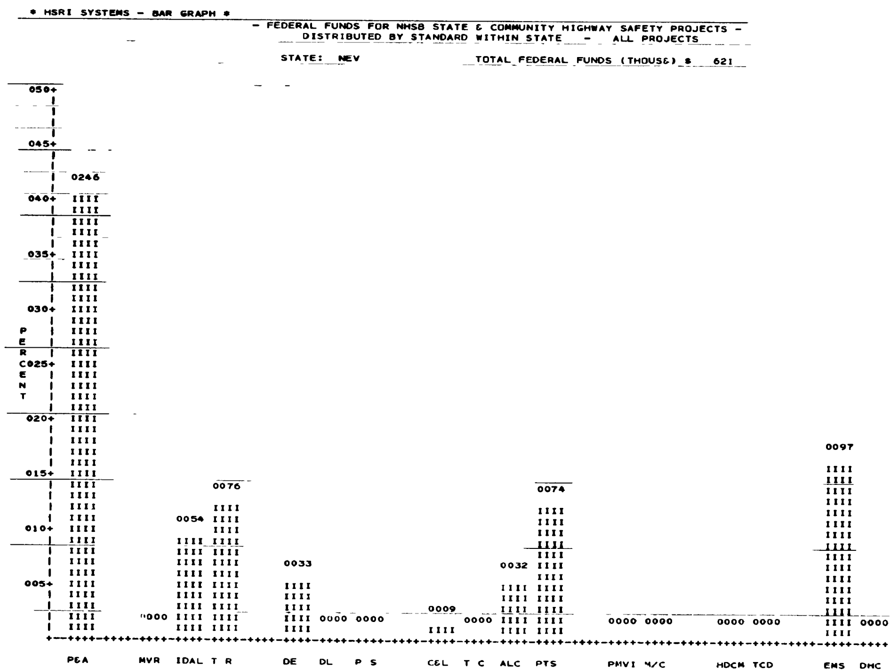
STATE: MISS TOTAL FEDERAL FUNDS (THOUS$) $ 1955

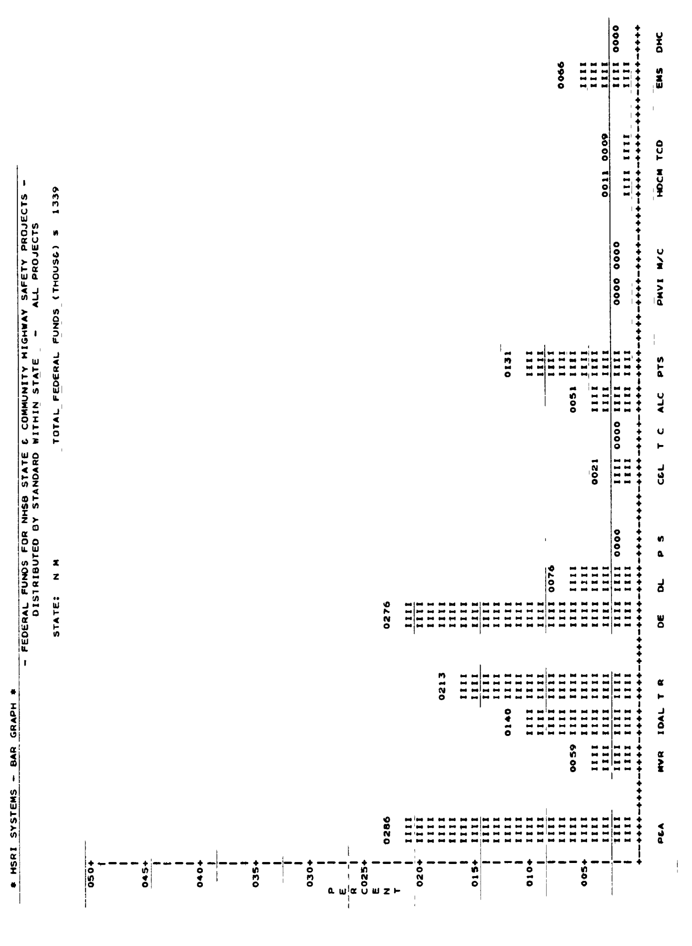



* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE MOU
TOTAL FEDERAL FUNDS (THOUS&) $
PERCENT
050 045 040 035 030 025 020 015 010 005
0316 0000 0092 0755 0762 0000 0012 0000 0008 0047 1404 0000 0000 0000 0043 0534 0004
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

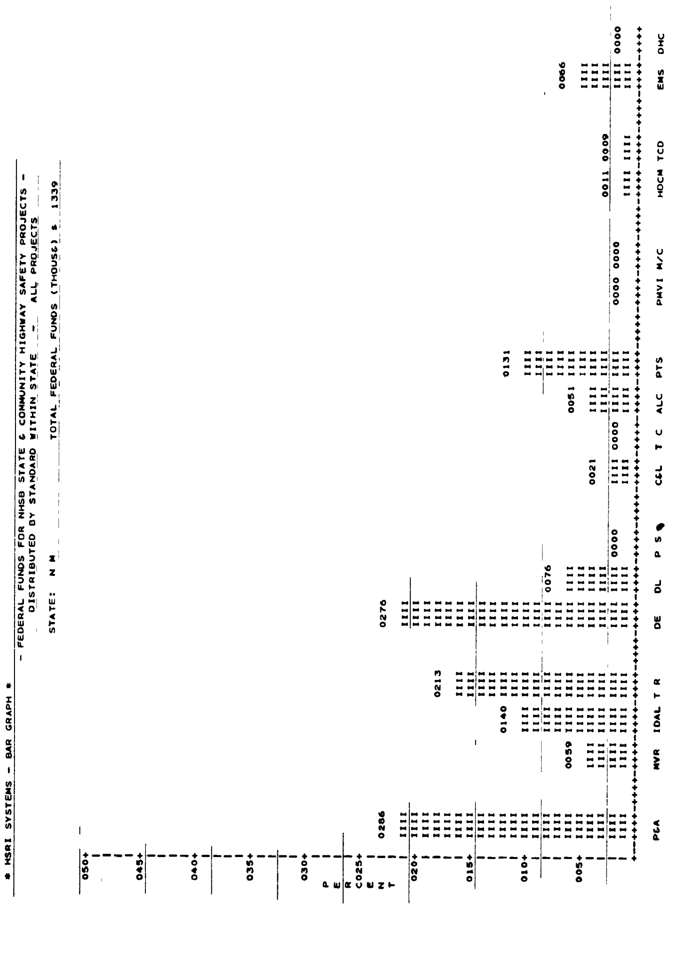

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE MONT
TOTAL FEDERAL FUNDS (THOUS&) $ 694
PERCENT
050 045 040 035 030 025 020 015 010 005
0091 0071 0000 0042 0161 0162 0000 0000 0000 0000 0000 0000 0000 0000 0049 0118 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

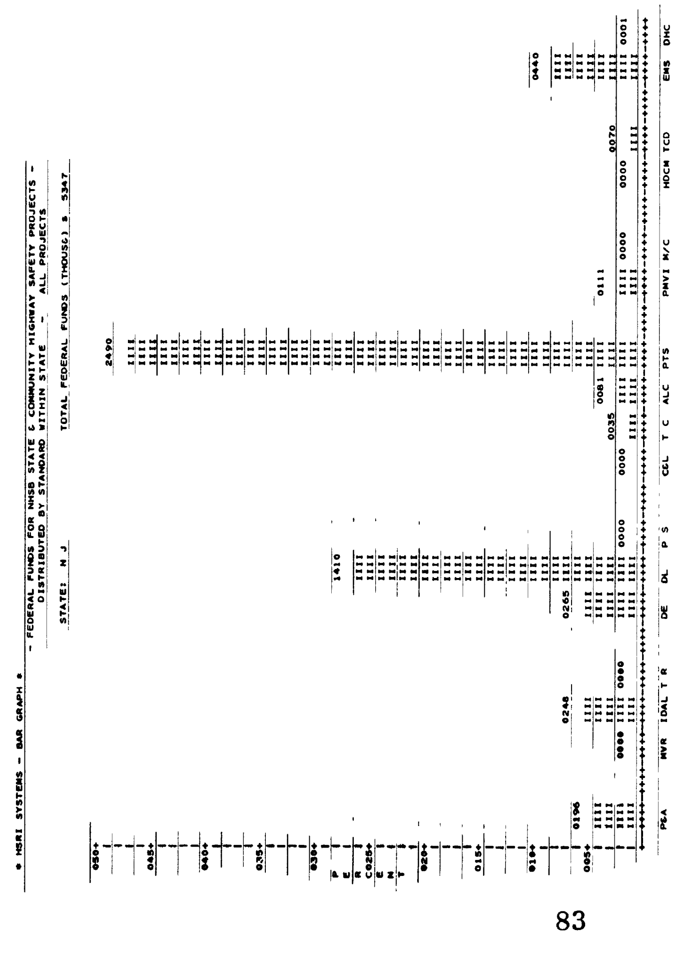

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: NEB
TOTAL FEDERAL FUNDS (THOUS&) $ 1385
PERCENT
050 045 040 035 030 025 020 015 010 005
0116 0000 0034 0075 0044 0147 0000 0000 0000 0002 0179 0115 0000 0038 0000 0614
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

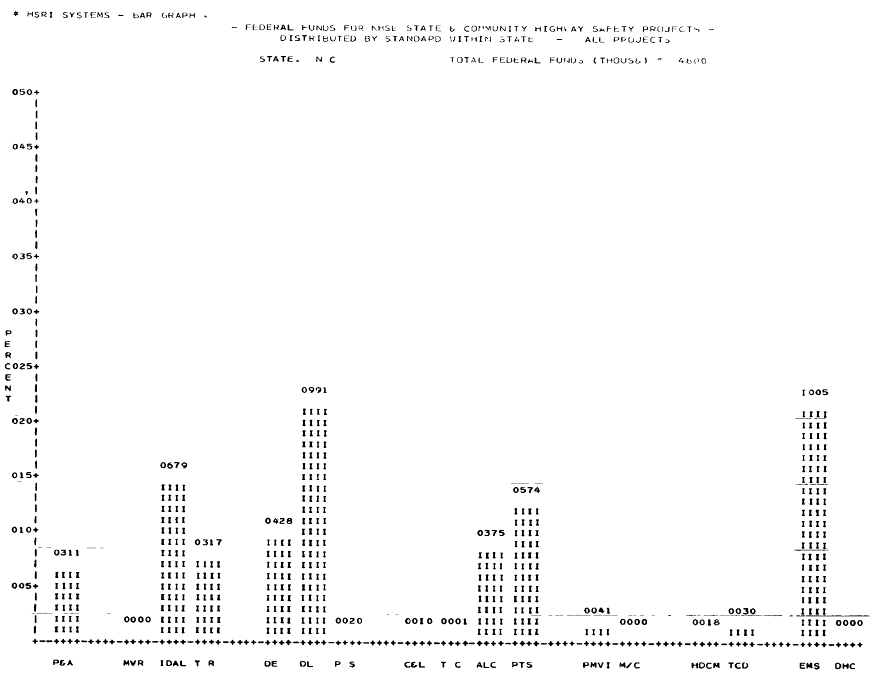

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: NEV
TOTAL FEDERAL FUNDS (THOUS&) $ 621
PERCENT
050 045 040 035 030 025 020 015 010 005
0246 0000 0054 0076 0033 0000 0000 0009 0000 0032 0074 0000 0000 0000 0000 0097 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

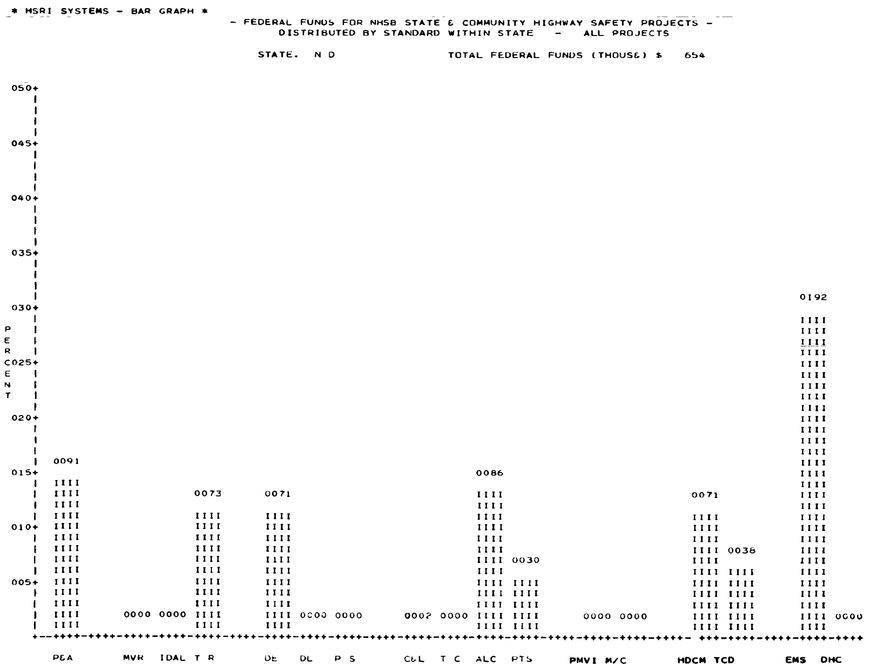

* MSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: N M
TOTAL FEDERAL FUNDS (THOUS$) $ 1339

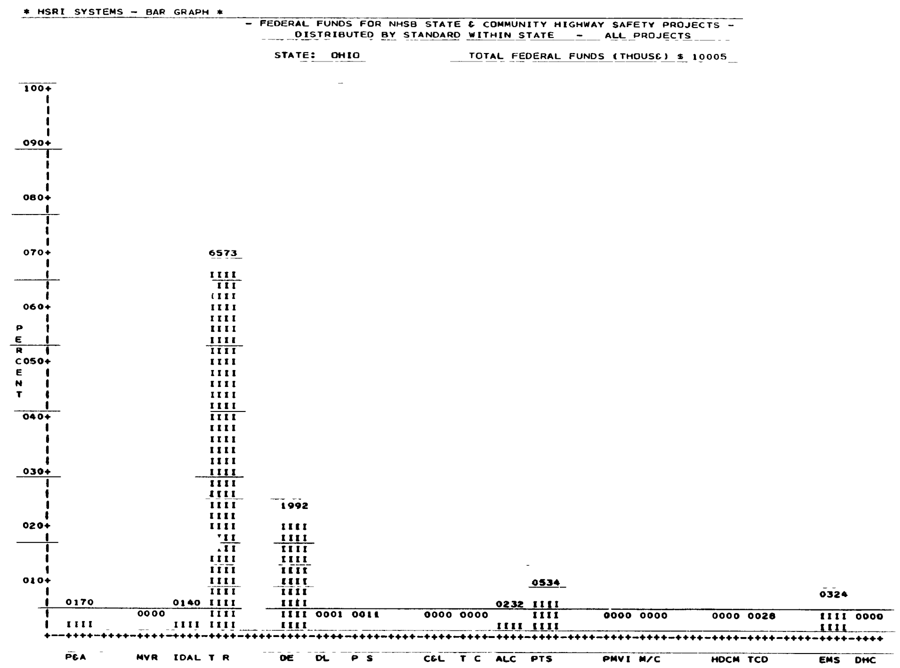

* MSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: N Y
TOTAL FEDERAL FUNDS (THOUS$) $ 16767

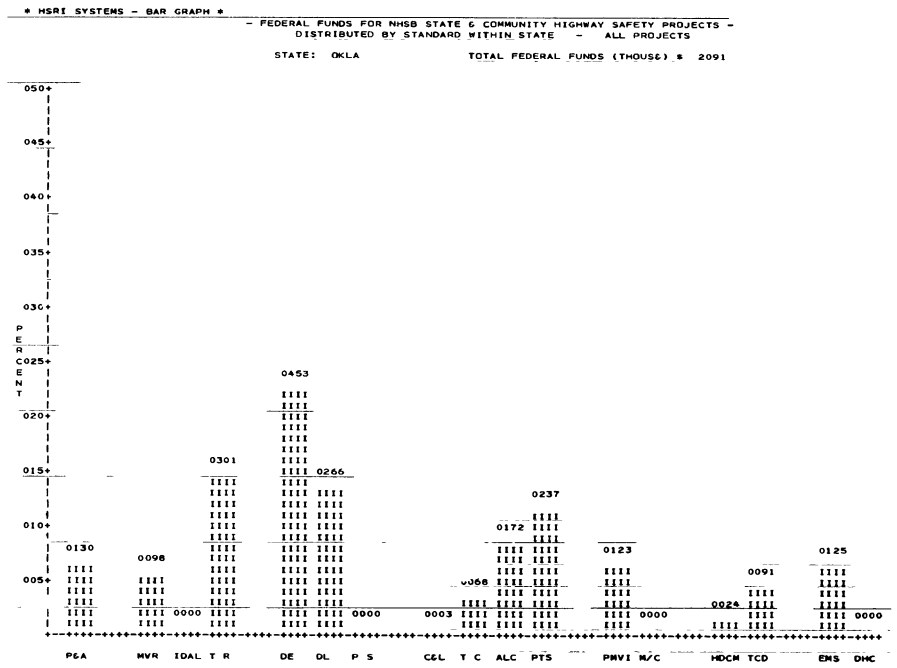

* MSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: N M
TOTAL FEDERAL FUNDS (THOUS$) $ 1339


* MSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: N J
TOTAL FEDERAL FUNDS (THOUS$) $ 5347


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE. N C
TOTAL FEDERAL FUNDS (THOUS$) = 4800
PERCENT
050 045 040 035 030 025 020 015 010 005
0311 0000 0679 0317 0428 0991 0020 0010 0001 0375 0574 0041 0000 0018 0030 1005 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE. N D
TOTAL FEDERAL FUNDS (THOUS$) $ 654
PERCENT
050 045 040 035 030 025 020 015 010 005
0091 0000 0000 0073 0071 0000 0000 0002 0000 0086 0030 0000 0000 0071 0036 0192 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

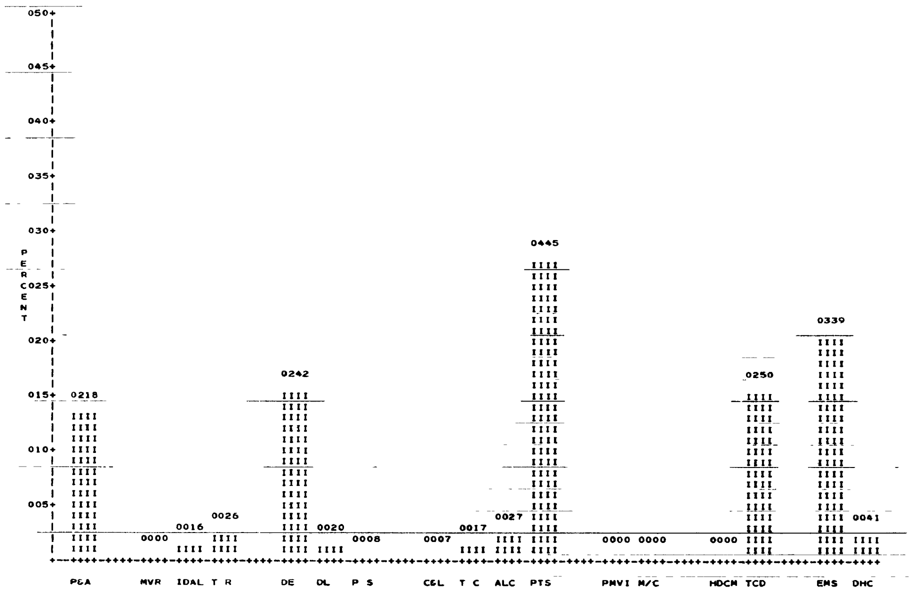

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: OHIO
TOTAL FEDERAL FUNDS (THOUS$) $ 10005
PERCENT
100 090 080 070 060 050 040 030 020 010
0170 0000 0140 6573 1992 0001 0011 0000 0000 0232 0534 0000 0000 0000 0028 0324 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: OKLA
TOTAL FEDERAL FUNDS (THOUS$) $ 2091
PERCENT
050 045 040 035 030 025 020 015 010 005
0130 0098 0000 0301 0453 0266 0000 0003 0068 0172 0237 0123 0000 0024 0091 0125 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

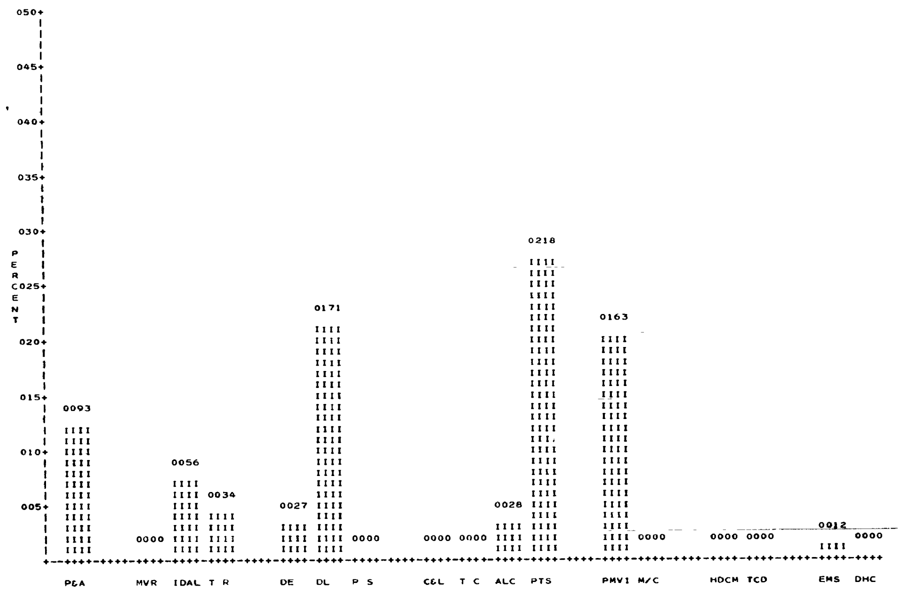
STATE: ORE TOTAL FEDERAL FUNDS (THOUS$) $ 1656



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

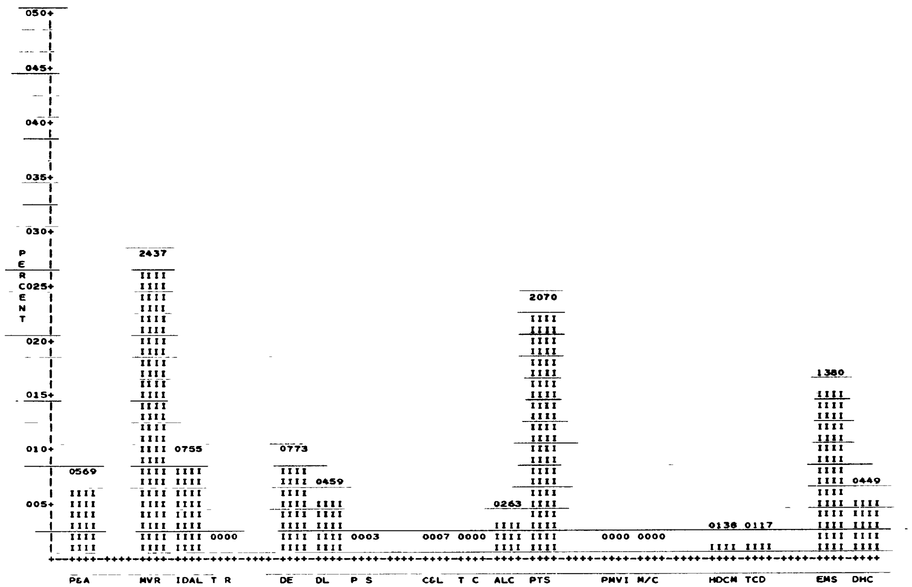
STATE R I TOTAL FEDERAL FUNDS (THOUS$) $ 802



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

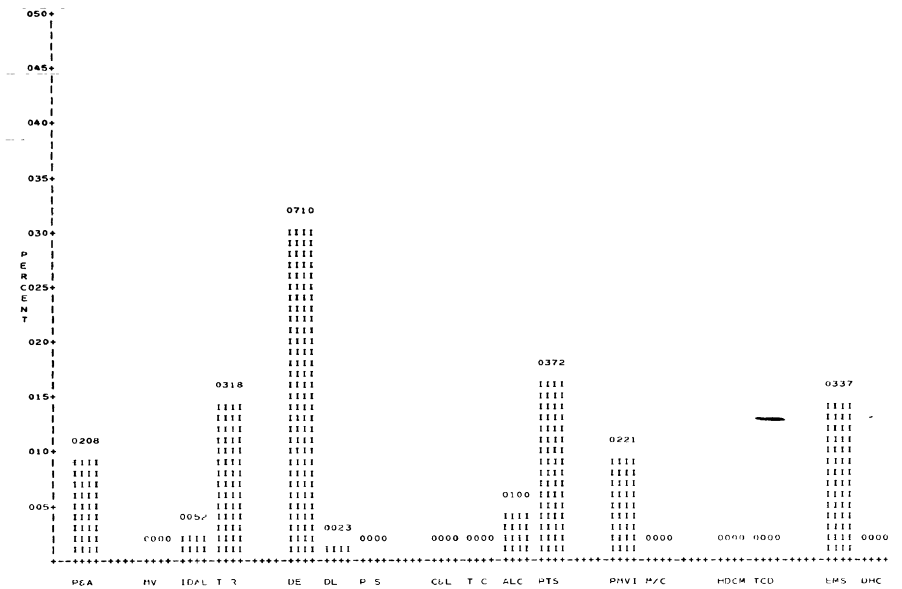
STATE: PENN TOTAL FEDERAL FUNDS (THOUS$) $ 9420



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

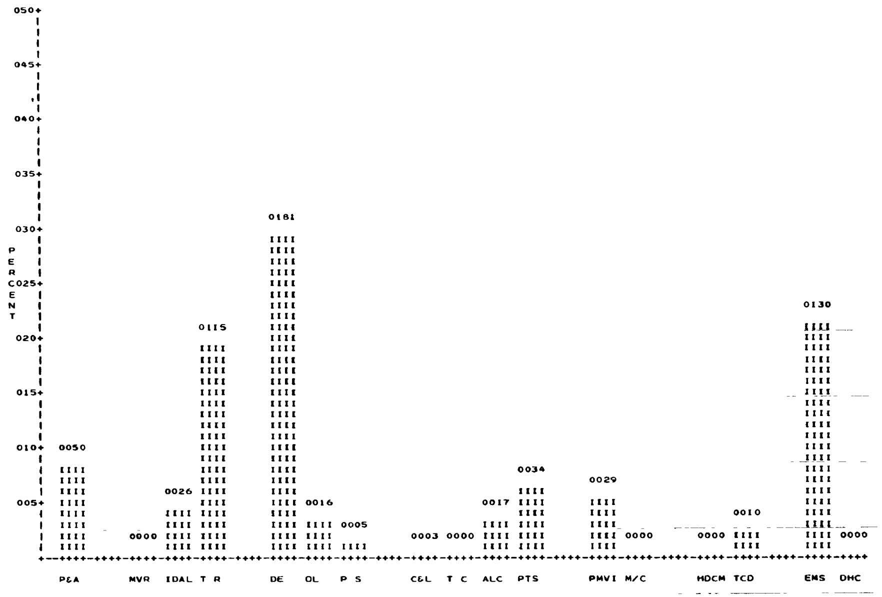
STATE S C TOTAL FEDERAL FUNDS (THOUS$) $ 2341



* HSRI SYSTEMS - BAR GRAPH *

\- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

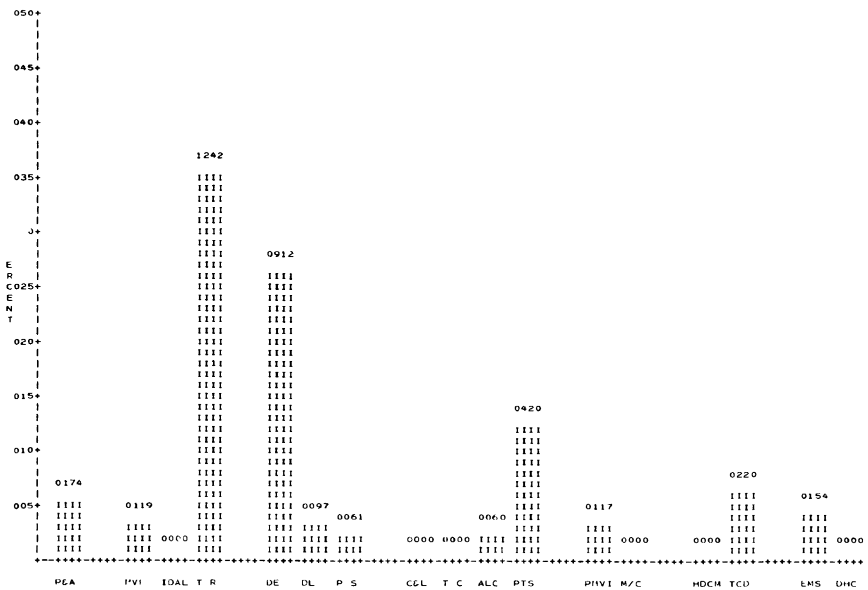
STATE: S D TOTAL FEDERAL FUNDS (THOUS&) $ 616



* HSRI SYSTEMS - BAR GRAPH *

\- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

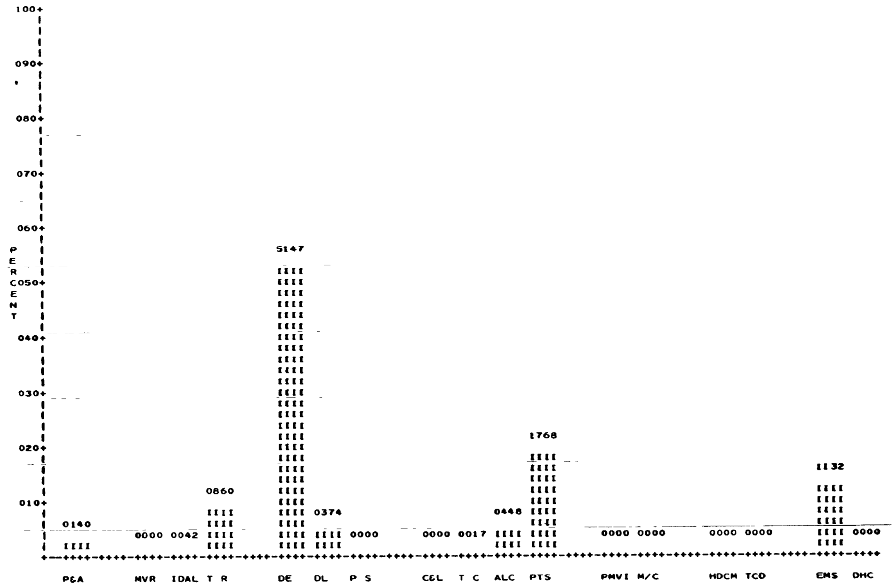
STATE: TENN TOTAL FEDERAL FUNDS (THOUS&) $ 3576



* HSRI SYSTEMS - BAR GRAPH *

\- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

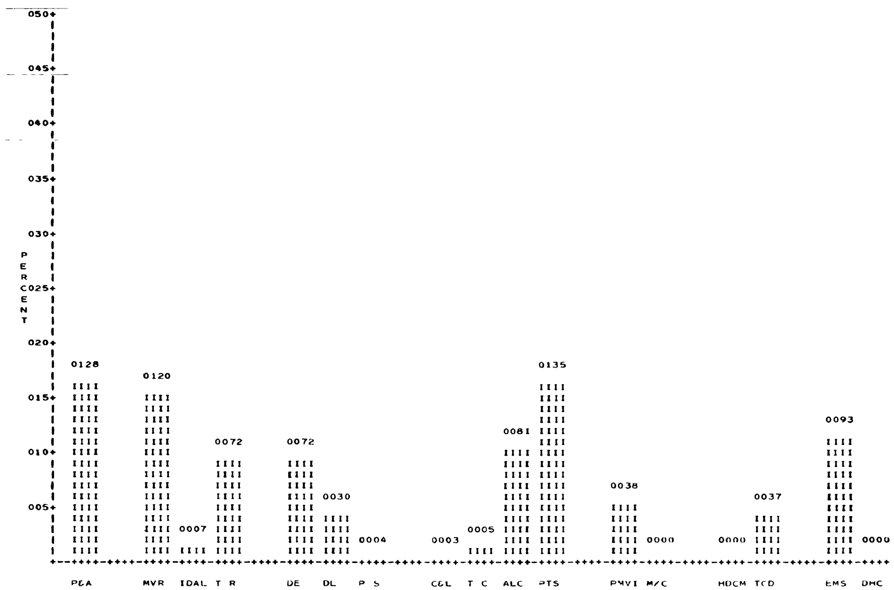
STATE: TEX TOTAL FEDERAL FUNDS (THOUS&) $ 9928

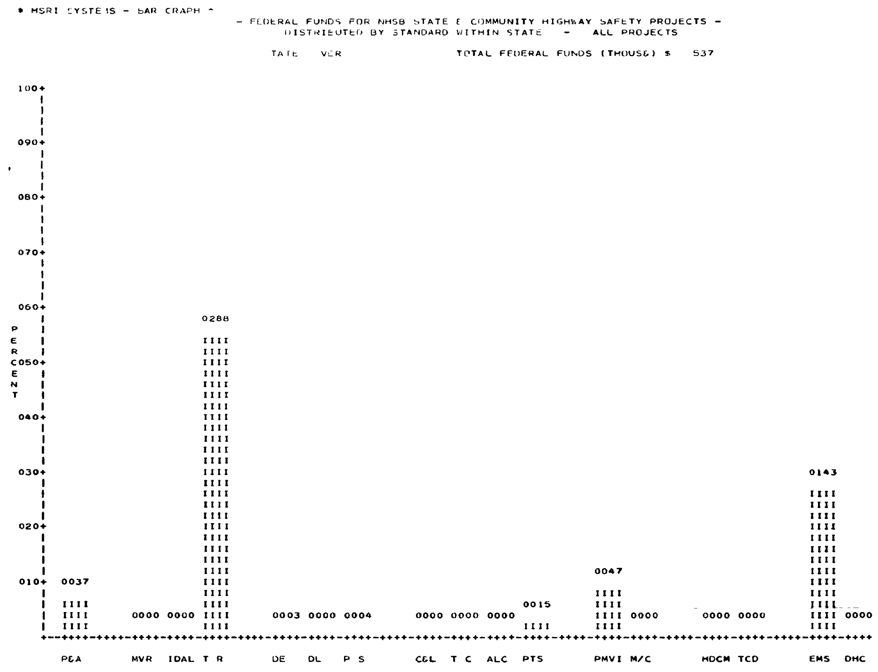


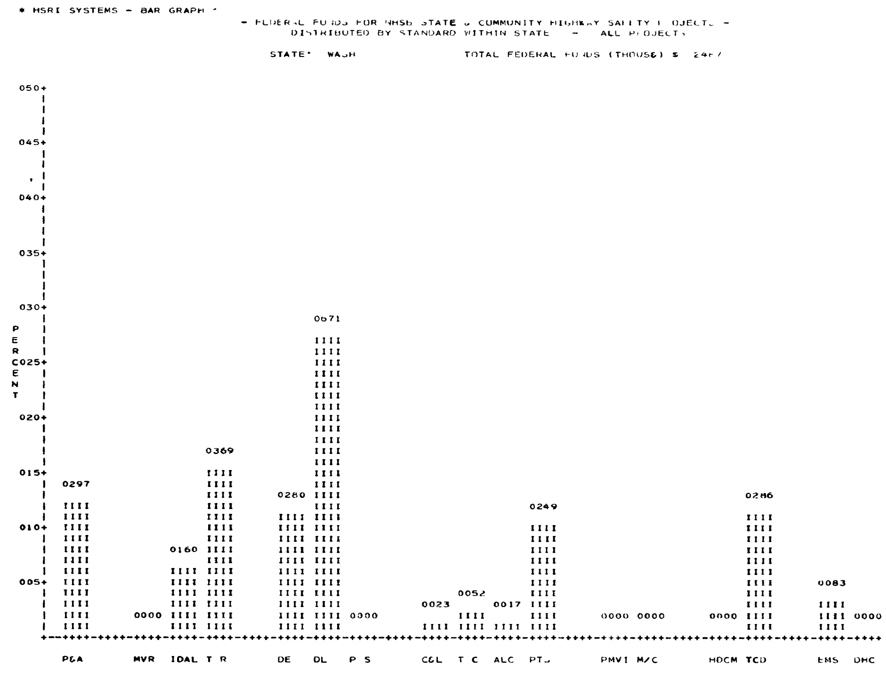
* HSRI SYSTEMS - BAR GRAPH *

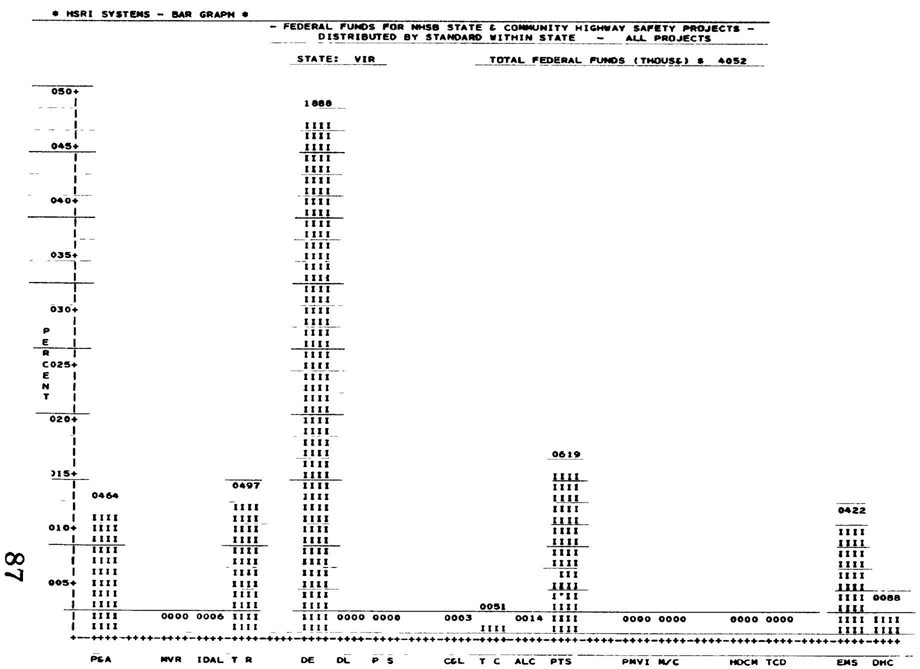
\- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

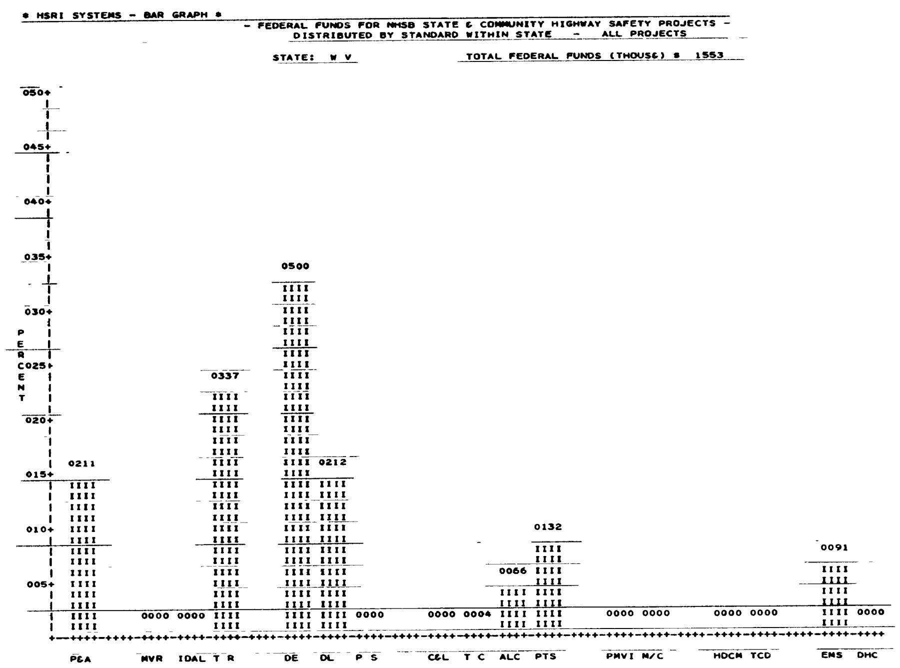
STATE: UTAH TOTAL FEDERAL FUNDS (THOUS&) $ 825




* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: VER
TOTAL FEDERAL FUNDS (THOUS$) $ 537
PERCENT
0037 0000 0000 0288 0003 0000 0004 0000 0000 0000 0015 0047 0000 0000 0000 0143 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: WASH
TOTAL FEDERAL FUNDS (THOUS$) $
PERCENT
0297 0000 0160 0369 0280 0571 0000 0023 0052 0017 0249 0000 0000 0000 0286 0083 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

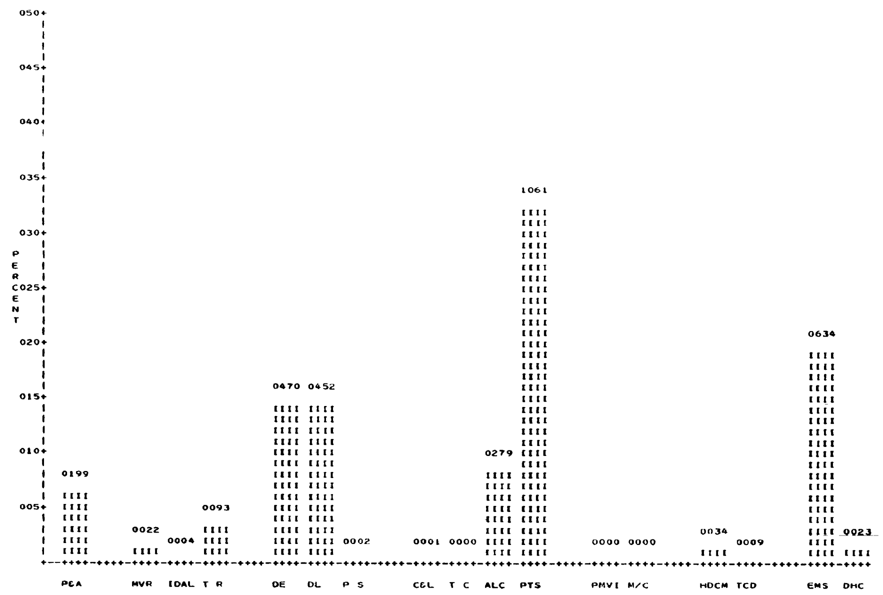

* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: VIR
TOTAL FEDERAL FUNDS (THOUS$) $ 4052
PERCENT
0464 0000 0006 0497 1888 0000 0000 0003 0051 0014 0619 0000 0000 0000 0000 0422 0088
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC


* HSRI SYSTEMS - BAR GRAPH *
- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS
STATE: W V
TOTAL FEDERAL FUNDS (THOUS$) $ 1553
PERCENT
0211 0000 0000 0337 0500 0212 0000 0000 0004 0066 0132 0000 0000 0000 0000 0091 0000
P&A MVR IDAL T R DE DL P S C&L T C ALC PTS PMVI M/C HDCM TCD EMS DHC

* HSRI SYSTEMS - BAR GRAPH

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

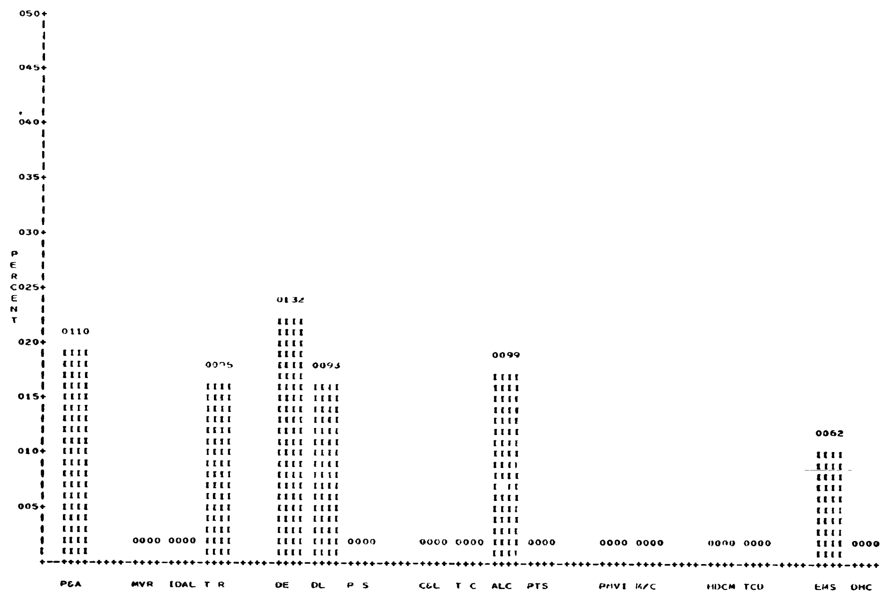
STATE: WISC TOTAL FEDERAL FUNDS (THOUS) $ 3283



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

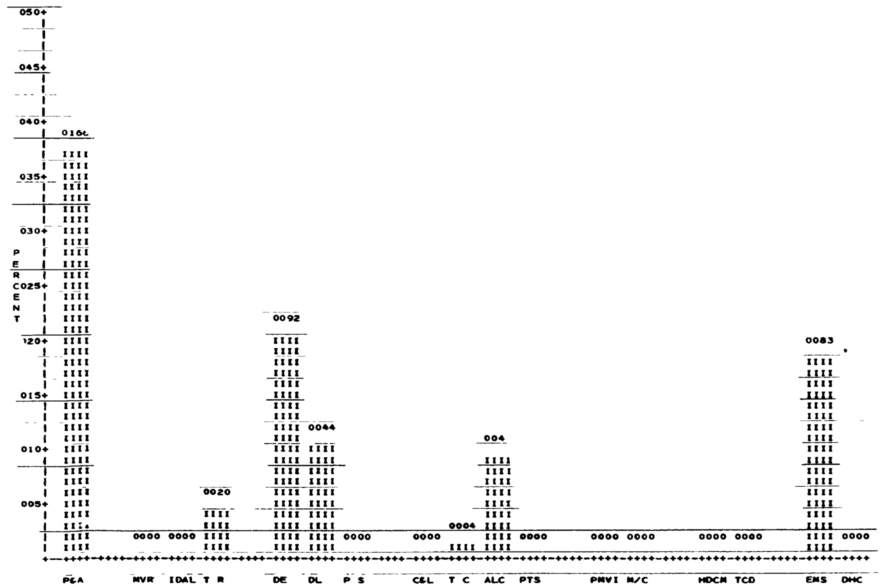
STATE: D C TOTAL FEDERAL FUNDS (THOUS) $ [illegible]



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

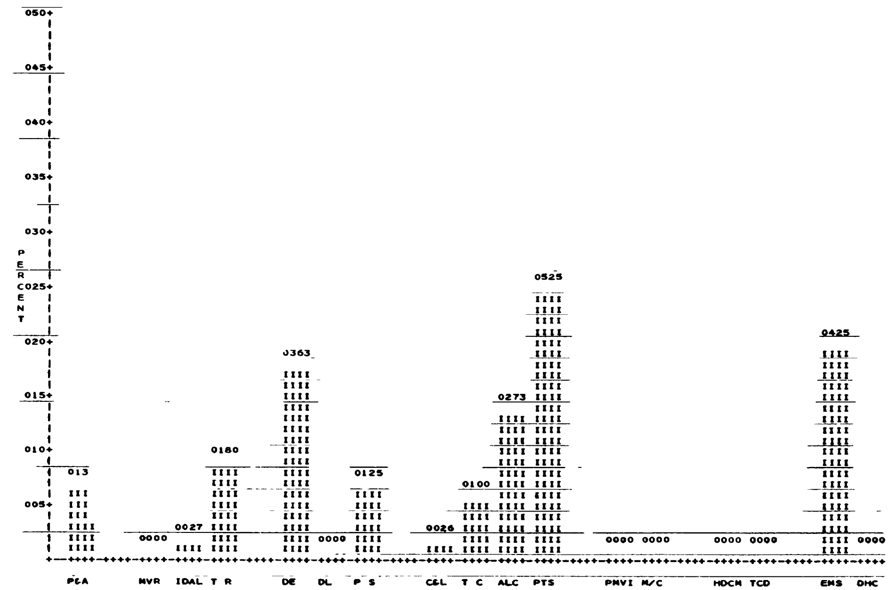
STATE: WYO TOTAL FEDERAL FUNDS (THOUS&) $ 450



* HSRI SYSTEMS - BAR GRAPH *

- FEDERAL FUNDS FOR NHSB STATE & COMMUNITY HIGHWAY SAFETY PROJECTS -
DISTRIBUTED BY STANDARD WITHIN STATE - ALL PROJECTS

STATE: P R TOTAL FEDERAL FUNDS (THOUS&) $ 2180



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1. D.T. Campbell and J.C. Stanley. Experimental and Quasi-Experimental Designs for Research, Rand McNally, Chicago, 1966.

2. "Bunker-Ramo Series 2200 CRT Terminals," Datamation, January 15, 1971, p. 5.

3. Highway Safety Program Manual: Traffic Records, Vol. 10, Chapter V, Paragraph 4, January 1969.

4. A Resource Curriculum in Driver and Traffic Safety Education, Automotive Safety Foundation, Washington, D.C., January 1970

5. Diagnostic Center: Final Report, Northern Research and Engineering Corp. Cambridge, Mass., July 1, 1970 (DOT Contract FH-11-7287).

6. An Evaluation of the Michigan Driver-Vehicle Check Lane, Highway Safety Research Institute, The University of Michigan, Ann Arbor (in preparation).

7. W. Carlson and W. Hall, Highway Safety Project Evaluation Methodologies, Highway Safety Research Institute, The University of Michigan, Ann Arbor, December 31, 1968.