Final Report
of the
Faculty Program Advisory Committee

May 1966
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HIGHWAY SAFETY RESEARCH INSTITUTE
THE INSTITUTE OF SCIENCE AND TECHNOLOGY
THE UNIVERSITY OF MICHIGAN
Ann Arbor, Michigan

FOREWORD

> The mission of the Highway Safety Research Institute shall be to create, collect, collate, analyze, and disseminate knowledge of the various factors influencing safety on the highways.

In December of 1965, The University of Michigan announced the acceptance of a ten-million dollar gift for the establishment of a Highway Safety Research Institute. Four million dollars were contributed jointly by the Ford Motor Company and the General Motors Corporation for the necessary buildings and facilities. The other six million dollars were contributed by the Automobile Manufacturers Association to support the first five years of research operations. Further support was contributed by the Fruehauf Corporation. These gifts imposed neither restrictions nor demands, other than that they be dedicated to the broad area of highway safety research.

Dr. Harlan Hatcher, President of The University of Michigan, designated Dr. A. Geoffrey Norman, Vice-President for Research, to direct the organization of this new enterprise. Dr. Norman in turn appointed Dr. Robert L. Hess, Professor of Engineering Mechanics and Associate Director of the Institute of Science and Technology, chairman of an ad hoc Faculty Program Advisory Committee. The Committee was composed of interested faculty members from disciplines including engineering, law, anatomy, economics, psychology, psychiatry, public health, sociology, statistics, and medicine.

The committee concentrated its accumulated knowledge and experience upon the tasks of defining and then combining the varied existing approaches to the highway safety problem into a unified, interdisciplinary program with clearly stated objectives.

The committee completed its studies and submitted its findings and recommendations to Dr. Norman April 25, 1966. The text of the committee's report, presented herein, is now submitted to the highway safety research community at large. It is our hope that the spirit of cooperation among men of different academic interests that made this report possible will be met by a similar desire in others to work together to meet the urgent demand for improved safety on our streets and highways.

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FINAL REPORT OF THE FACULTY PROGRAM ADVISORY COMMITTEE

1. INTRODUCTION

There is a sincere desire, at all levels within the University, to develop a fully structured expertise in highway safety research covering the several disciplines which intuitively seem necessary if the Institute is to reach its goals, i.e., to assume a recognized, causative role in the reduction of morbidity and mortality rates; earn a reputation as a center of engineering and scientific knowledge on highway safety; and make a meaningful contribution to the educational role of the University.

It does not appear that defining discrete problems in terms of specific disciplines, solving them, and reporting the results in the professional journals of those disciplines could be expected to result in reasonably direct action on the part of industry, the public, or the government to effect a measurable reduction in morbidity and mortality from highway accidents. Rather it appears that problems should be attacked simultaneously on several levels or from several different but interrelated research points of view, and the results communicated as widely as possible among all the many and varied groups capable of stimulating or initiating direct action programs based upon these results. To meet this aim, the series of highly technical or scientific papers which will naturally result from the research program should be supplemented by additional interpretive papers which would present the studies and their conclusions and implications in an appropriate "layman's language."

2. THE NATURE OF THE PROBLEMS

In general, it appears that the public and its representatives, along with the industries, operate together to develop roadways, vehicles, and personal restraints or controls which improve economy, convenience, and pleasure, but which reflect inadequate understanding of safety implications in their design, operation, and control. Thus we find that vehicles have poorly understood limits of controlability under different loading, driving, and roadway conditions and it is highly probable that mechanical failures are responsible for a significant, if as yet unknown, number of control-failure accidents. We find that too many drivers are inadequately skilled in the techniques of safe driving, particularly in those techniques for anticipating and avoiding unexpected and dangerous events, and for various reasons are often insufficiently concerned about the possible consequences of their actions to themselves or others. We find that some roadways are poorly designed for today's vehicles and traffic levels, and that most roadways provide unnecessary off-road obstacles to interfere with possible vehicle paths. And finally, we find that when an accident is in progress, the passengers are subjected to high risks of personal injury resulting from forcible contact with the interior of the vehicle itself. We know, at this time, very little about the effectiveness of various measures (e.g., education, publicity, legal sanctions) to encourage the application of known sound principles of roadway construction, vehicle design, and driver behavior. These problems can be expanded upon in great detail, but the purpose here is to assist in recognizing the complex nature of the problems that exist today and how these problems must influence our research program. While it is extremely important that better training be provided for new drivers, and that improved design techniques be applied to new vehicles and roadways, it will take a considerable amount of time to influence the heritage of past years of accepted practices of training and design. Thus, while it is proper to look forward to an optimum highway transportation system, we must consider such progress in terms of an evolution from the present system. We should, therefore, first acquire a full knowledge of the present system in order to recognize and then direct our efforts toward the most rewarding research areas.

3. AN INFORMATION CENTER

It is apparent that the Institute should acquire a full-time professional staff to operate a Highway Safety Research Information Center. The Information Center would perform the following two functions:

(1) Develop an organization capable of carrying out literature searches, analyzing the material, and preparing state-of-the-knowledge reports, including expert criticism of the analysis. Its capability should be such that several, as many as a dozen, state-of-the-art reports might be in preparation at the same time. The major research groups and/or the executive committee of HSRI could define a series of subjects upon which state-of-the-knowledge reports are desired. Given this information, and given the relative priorities and the depth of study required for each, the staff of the information center should be able to initiate all the necessary actions to compile such reports in what is generally accepted to be a reasonable length of time.

(2) Develop a system capable of holding, or making otherwise readily accessible, a sufficient quantity of information to permit answering specific limited questions readily and in some cases rapidly. (A typical question might be illustrated by the recent request from an out-of-town source for information on what studies have been done relative to the improvement of safety in school buses.)

The first of these two functions (the state-of-the-knowledge reports) can be readily seen to be a matter of prime importance in establishing direction for the information center staff.

The second (specific question answering) involves a matter of HSRI and University policy. It must be determined whether this kind of service should be provided for any and all requesters, or only for those involved in our own research. The probability is that the local researcher would wish to participate in the answers to his own questions, whereas it is not likely that questions coming from outside would often be questions in which our researchers would be deeply involved. There would be a difference in the numbers of requests from outside and from inside, and a difference in the time allotted for response; the outside question would probably require a more rapid response than an inside question.

It would appear that, at this time, we should not commit ourselves to providing a public question-answering service. We do not know whether the physical and staff costs for providing such a service would be justified by our research objectives.

We should institute a careful study of various mechanized information systems capable of yielding quick answers to small questions. This study should be performed within approximately a six- to eight-month period, should include a full study of the financial implications, and should consider the need for additional support for the implementation and the service.

The information center might also be responsible for publishing a technical bulletin or scientific periodical. There is at this time no single respectable scientific and scholarly journal for publications in the area of traffic safety. "Respectable" in this context implies a publication comparing in quality to the Journal of Applied Physics, for example. Because highway safety cuts broadly across many fields, and because researchers generally find great value in special issues of good publications, we might consider publishing a journal which cycles its monthly issues to cover in turn such special interests as Information Theory, Human Factors, Public Factors, and Engineering Factors, with each interest represented by three issues each year.

To be successful, such a publication would require an editor almost exclusively concerned with the publication of the Journal. While the editor could be a person of scientific background, a professional editor could handle the task. This journal should issue invitations for papers; in the first few years this would help assure the success of the publication itself, and in later years would assure a proper balance of the material being presented.

4. SYSTEMS ANALYSIS

When considering systems analysis, there is reason to believe that if it is left to any one person or small group to perform a systems analysis, the results will not be as complete as they should be. That is, people in different disciplines will probably discover omissions or weaknesses not apparent to those outside the disciplines. It is suggested that at the outset we consider several groups working independently, each to provide its own version of an overall systems analysis of the field of highway safety. Integration of these studies will assure that the systems analysis to be used as a base for continuing program decisions will be more complete and better balanced.

5. SUBCOMMITTEE RECOMMENDATIONS

The research program recommendations for HSRI have been developed in terms of public, individual (or human), and physical factors, and are summarized below in Sections 5.1, 5.2, and 5.3. The inevitable overlap of areas was considered desirable in our total committee approach, emphasizing as it does the need in many of the problem areas for a multidisciplinary research approach. As might be expected, each area also includes several single-discipline subareas. It is of the utmost importance that the research program of HSRI be established upon a sound evaluation of the various recommendations for research given in the next paragraphs. Research objectives must be defined in terms of the immediate results desired from the research, and the significance of these results to the overall problem. At the time of this writing, specific objectives and the basis for this evaluation process have not been defined. Achievement of these goals must be given the highest priority by the executive committee and the senior staff of HSRI before long-range commitments to major portions of the program are established.

5.1. PUBLIC FACTORS

In the preparation of its research program proposal, the subcommittee became increasingly aware of the wide range of highway safety implications. It was also reminded that the specific format such a program would ultimately assume would depend in no small degree on the interests and competences of the permanent Institute research staff and on the accident of opportunity for development in one or another direction. Consequently, the subcommittee took the position that its task was one of identifying the principal categories of research problems and of elaborating on each category with an illustrative list of specific research topics. The four categories identified by the subcommittee are described in Sections 5.1.1, 5.1.2, 5.1.3, and 5.1.4.

5.1.1. ATTITUDES AND VALUES. The attitudes and values associated with car ownership, driving, and public safety regulations extant in the present culture should be regarded as basic data for many lines of research that might be pursued. They define the context in which safety questions arise and in which resolutions to such questions are put forth. It is necessary to know not only the salient features of that context, but also the possibilities of altering and reshaping them. The following illustrate some of the possible subjects for research in this broad area of concern.

(1) Relative importance of the value put upon automobile driving: by teenagers, women, household heads, the aged, the Negro, others

(2) Attitudes of parents toward teenage driving

(3) Attitudes toward, and knowledge about, safety regulations

(4) Possibilities of affecting safety attitudes through various means, e.g., mass media, schools, driver training

(5) Attitudes toward rigorous law enforcement held by different sectors of the public

(6) Attitudes toward responsibility for safety, e.g., the driver, the manufacturer, government, police

(7) Influence of safety considerations in car purchases

(8) Extent to which laws and court actions reflect prevailing attitudes

5.1.2. THE DRIVER. Since in many respects responsibility for safety observances rests with the individual driver, it is necessary to know as much as possible about driving behavior and the personal, social, and legal factors affecting it. For example:

(1) Factors involved in driver selections and exclusion: legal, insurance, other

(2) Risk taking: variation with types of people and types of circumstances

(3) Compliance rates for different types of safety regulations

(4) Carry-over of social experiences (e.g., crises) to driving behavior

(5) Effect of passengers on driving behavior

(6) Group membership (characteristics common to safety violators as a group, especially the accident-prone driver)

(7) Factors affecting learning and observance of safety regulations

(8) The costs of accidents: immediate and deferred costs; financial and social costs

(9) Evaluation of safety campaigns, e.g., NSC predictions of holiday deaths

(10) Explorations of methods of affecting driver behavior

5.1.3. THE APPLICATION OF LEGAL SANCTIONS. A large area of uncertainty concerns the effectiveness of safety enforcement measures as they are applied to various segments of the population. Much needs to be known, too, about the legal limitation of enforcement and the actual administration of enforcement of safety measures. For example:

(1) Constitutional rights of drivers, viz. arrests, searches, and tests

(2) Enforcement problems in various regulations

(3) Costs of enforcement

(4) Educational influence of penalties, effects of severity of penalty

(5) Police organization and enforcement effectiveness

(6) Extent and nature of discretion exercised by police in enforcement

(7) The legislative process: the influence of pressure groups, of insurance costs, of public attitudes

(8) Safety costs: installation, maintenance, inspection, insurance

5.1.4. THE COMMUNITY. The community, broadly viewed, is a diffuse though nevertheless significant factor in the observance and promotion of safety regulations. Its influence extends from the form of its spatial and temporal patterns, through its fiscal, legal, and administrative systems, to its less formalized information networks and group structures. Its concerns include:

(1) Physical design and safety: effectiveness of bypasses and limited access, arrangements of land uses relative to streets and roads, protection of the pedestrian, economic analysis of highway designs

(2) Temporal sequence of community functioning: high-risk periods of the day

(3) Resources for safety control: voluntary groups as educational influences, health organizations, local ordinances

(4) Information flows and discontinuites: to public, to officials and other decision makers

(5) Expenditures for safety regulation, by type of community

(6) Rehabilitation of the injured: organization of programs, costs, responsibility for costs

5.2. HUMAN FACTORS

A key research effort within HSRI must seek to relate the characteristics of operator performance to the occurrence of own-vehicle or other-vehicle accidents. With an adequate set of procedures for identifying and measuring operator performance in a wide variety of vehicle-driving tasks or situations, it should become possible to use critical features of this performance variable—rather than accident statistics—as the dependent variables in studies of the effects of social, legal, and other "public" variables, as well as the effects of the "physical" variables of highway design, vehicle characteristics, and highway or vehicle signal systems.

A brief outline of the recommended subprograms follows.

5.2.1. OPERATOR BEHAVIOR CHARACTERISTICS. It is widely recognized that accidents and law violations represent only a small fraction of the tail of a distribution of operator behaviors if such could be placed on a scale ranging from adaptive to maladaptive. Accidents and violations represent, therefore, a highly selected sample of critical incidents and this fact makes statistical inferences about the behavioral factors underlying the accident or violation extremely hazardous. This difficulty is compounded by the requirement, in the case of accidents at least, that the antecedents of the accident be reconstructed from survivor and observer testimony, which is unreliable, or from objective evidence which is inherently inferential. Clearly, what is needed are observations and measurements of the behavior of operators before the accident, or, more generally, of the behavior of drivers throughout the range of driving tasks and conditions, including, but not limited to, those that result in accidents.

The immediate objectives of such a program would be (1) the development of a descriptive taxonomy of vehicle-operator tasks; (2) the determination of the central tendency and variability of within-operator and between-operator performance in those tasks, with special emphasis on the occurrence of "breakdown" performance; and (3) the identification of "critical" behaviors in situations that have high accident potential. An important feature of this analysis would be the development of a taxonomy of situations that have high accident potential.

Suggested objectives in this area are, for example:

(1) Identification and Analysis of Critical Behavior

(a) Important evidence leading to the identification of normal and emergency requirements can be obtained from the application of a "critical incidents" technique that has been widely used for similar purposes in military psychology.

(b) Detailed log-book recording of accidents and near-accidents may be obtained from a pool of volunteer driver-reporters.

(c) Driving instructors, highway patrolmen, and racing drivers may be interviewed to obtain their judgments about critical behaviors, skills that are difficult to learn, and procedures for learning. Of particular interest are interviews with instructors involved in the training of high-skill groups such as highway patrolmen and motorized urban policemen.

(2) Actual Driver Performance

(a) Vehicle-specific observations in which the vehicle is instrumented to record the control actions of the operator, the dynamics of the vehicle, and the signal system operation of the vehicle. The concept here is similar to the "flight recorder" of aircraft, but with information about operator responses and signal system that are specific to automobiles and trucks.

(b) Situation-specific observations in which there is a quasi-random selection of operator-vehicle units for observation without the operators' knowledge and without identification of operators.

(3) Simulation and Simulators for Determining Driver Performance

(a) Simulation of all types may be used to (1) serve as a measure of operator proficiency, (2) serve as a training device, and (3) serve as a tool for the analysis of operators' capacities and limitations.

(b) Simulation must include normal driving tasks and emergency tasks

(c) While part-task simulation should be emphasized in the research, whole-task simulation may be required to study operators' foresight and planning failures in connection with low-probability events.

5.2.2. FACTORS AFFECTING OPERATOR PERFORMANCE. The program of observation and recording of vehicle-operator behavior (Section 5.2.1 above) is a methodoligical preliminary to an experimental and theoretical program concerned with the factors that affect operator performance. That program involves the development, testing, and validation of different methods for observing the behavioral effects of changes in the environment, the operator, or the vehicle that may be presumed to be related to the occurrence of accidents. The program of this section would attempt to organize, categorize, and show the interrelations of those factors that influence operator behavior.

The program of human factors research in highway safety requires a conception of the environment-operator-vehicle system. Such a conception offers the advantages of (1) segregating the factors without losing sight of their potential interactions, (2) categorizing the factors in a way that immediately suggests the loci of corrective actions for the improvement of highway safety, and (3) suggesting the loci of constraints that must be placed on corrective action as a consequence of other criteria of primary system performance and external criteria.

Suggested topics of study are, for example:

(1) Process Components of Operator Performance

(a) Analyze the within-operator information-handling processes involved in vehicle operation, determine the limitations of these adaptive processes, and determine the ways in which these limitations can be relieved by training, selective licensing of operators, or by modifications of the extra-vehicular or vehicular environments of the operator.

(2) Training and Education

(a) Determine what skills for safe vehicle operation should become the objectives of a training program

(b) Design, develop, and test training devices and their utilization in a vehicle-operator training program

(c) Develop programs of individual learning experience on the device(s) as a necessary part of a program of training research

(3) Operator Capacity— Attenuating Factors

(a) Fatigue

(b) Prescribed or proprietary drugs

(c) Deterioration in perceptual-motor, judgmental, and decision tasks as a function of age

(d) Chronic medical conditions

(e) Emotional illnesses, including chronic alcoholism

(4) Human Factors Engineering— the Vehicle (a collaborative effort of behavioral and physical scientists)

(a) Sensing of the environment

(b) Instrument displays

(c) Compensation for "error tendencies" in "normal" human response to operator-vehicle interactions

(5) Human Factors Engineering— The Environment (a collaborative effort of behavioral and physical scientists)

(a) The design of streets and highways, intersections, interchanges, road shoulders, medians, etc.

(b) The design, location, and coding of command signals

(c) The design, location, and coding of informational signs

(d) The instrumentation of other vehicles to provide information regarding intended action along with or in advance of such action

5.3. PHYSICAL FACTORS

5.3.1. THE VEHICLE. Major subdivisions of physical research directly related to the vehicle, its design and operation are described below:

(1) Automobile Structural Design: There is practically no available knowledge nor any current work outside the automotive industry on the general problem of automobile structural design. Basic principles are needed to guide designers and to train engineering students; such principles are not known to exist. Basic work in the areas of large deformation and impact resistance of structures is required. The development of basic structural principles should be pursued and should emphasize design with the goal of minimizing accident injury to the passengers. Particular topics would include the following:

(a) Energy-absorbing materials

(b) Plastic wave propagation

(c) Geometric effects on energy absorption

(d) Optimum structural configurations

(e) Application to automotive design

(2) Mechanical Aging, Maintainability, and Reliability: Considerable degradation occurs in a passenger vehicle's brake, suspension, and wheel systems during its normal road-life. In addition, corrosion of vehicle elements is severe in some regions. The open literature appears to contain practically no information on these subjects. Vehicle inspection programs, based upon sound engineering analysis, would appear to have a meaningful role in the reduction of highway accidents. Public administrators (and legislators) will require advice on critical items and techniques of inspection. This area of research has the combined positive values of providing service to the public and training for engineering students.

(3) Traffic Dynamics: Considerable work has been done in the dynamics of heavy traffic flow. Theory development and data gathering appear to have been primarily descriptive in nature. The techniques used have been:

(a) Probabilistic models affording random representations of individual vehicles

(b) Differential equation representations of car-following dynamics

(c) Fluid-flow analogies

Some real-time experimentation with heavy traffic flow has been carried out. Opportunities to contribute directly to the highway safety problem exist in the following areas:

(a) Development of risk-taking models of drivers relating the local traffic flow and the information available to the driver (present information levels and projected levels with improved sensing and informing systems)

(b) Development of safety-oriented models of traffic including driver behavior based upon decision-making as a variable

5.3.2. AUTOMOBILE STABILITY AND CONTROL: The degree to which the directional mechanics of automobiles influences the operational safety of the driver-vehicle-environment system is a highly elusive question. It is not possible to draw firm conclusions, relative to the role played by the physical and mechanical characteristics of the vehicle, without taking into consideration the variable characteristics of the driving public and the circumstances in which the vehicle-driver combination is expected to operate. The majority of a reasonably well developed theory has been developed to date by assuming the driver and the environment to have fixed properties and arbitrarily removing these factors from consideration. "The real challenge to the researcher is to discover those aspects of vehicle behavior that interact with the characteristics of the driver and the roadway environment in a very subtle fashion to cause, in a random fashion, an operational breakdown." (Quoted from a study conducted by L. Segel, Cornell Aeronautical Laboratory, Inc., for HSRI.) Recommended studies include:

(1) Construction of a system definition of the potential for breakdown, including vehicle stability and control characteristics, and the performance limitations of human operators as significant variables

(2) Analysis of the alteration of the above potential by speed increases: tire characteristics, loading, acceleration, etc.

5.3.3. INTERACTION OF DESIGN AND SAFETY. It is a general feeling that automotive design practices and a "safety engineering" approach to internal and external features representing potential sources of injury in accidents are not incompatible. It is proposed that a team experienced in design practices, human factors engineering, engineering practices, and medical investigation of accidents should work together to develop underlying principles which may be evaluated.

5.3.4. PASSENGER DYNAMICS. The subject of passenger dynamics has received research attention in terms of computer models, dummy crash tests, and accident investigation. It is felt that it would be fruitful to investigate this area further in the laboratory using several passenger subjects with varying postures and strategies in a variety of automobiles under low-velocity impacts. "Initial conditions" of passenger dynamics and direct experience in extrapolation to injury-producing objects could be statistically determined. (Questions of liability for possible injury to test subjects must be investigated before developing this type of program further.)

5.3.5. BIOMECHANICAL ASPECTS OF INJURY. Studies of the effects of impact on the human body have been extensive but have centered upon animal, dummy, or cadaver experimentation. A program in this area has been recommended, but the ideas remain quite general. They include, however, an apparent interest in studying (as part of an autopsy procedure) the impact tolerances of the upper limbs, the chest area, and internal organs.

5.3.6. CAR-ROAD INTERFACE. Skid mechanisms are known to be major factors in a large percentage of accidents. However, there is very little skid research being conducted in the United States today. The automotive tire is a complex orthotropic toroidal shell whose stress and deformation analysis is just beginning to be understood by researchers, and whose skid resistance characteristics are treated as an art rather than a science. The driver is considered to have only limited experience in coping with skids. Tire dynamics in general and skid mechanisms in particular strongly affect vehicle stability and control— especially in moderately high-speed maneuvers in emergency situations. It is recommended that the following topics be investigated:

(1) Friction of rubber and rubber-solid mixtures (basic work)

(2) Interaction of suspension-tire combinations on skid mechanisms

(3) Increased skid resistance of tires versus increased noise and wear (an analysis of cost of added safety)

(4) Anti-skid braking mechanisms

(5) Tire inspection and tire safety standards

5.3.7. HIGHWAY DESIGN AND MATERIALS. Physical research has been recommended on environmental factors including the highway itself, the appurtenances necessary for the control of traffic, the weather, and nonhighway natural and man-made forms at the roadside. Specific topics include:

(1) Road surfaces

(2) Detection and control of surface conditions such as ice and snow

(3) Provision of energy absorption systems for permanently installed structures

(4) Road and roadway design, including the simplification of vehicular interactions and the effects of roadway features such as slopes, drainage structures, etc.

(5) Traffic control devices (active)

(6) Introduction of more sophisticated use of accident records by highway design engineers

5.3.8. SENSING AND MONITORING DEVICES. The general area of techniques to detect and communicate to the driver information relative to the environment of a vehicle needs considerable investigation. The factors to be detected, and the modes (i.e., visual, audible) and speed of communication should be considered in conjunction with the Human Factors programs concerned with driver-information and decision-making studies. The possible physical techniques, along with their characteristics, capacities, and costs, should be surveyed to provide a basis for deciding what direction to take in this field.

6. CONCLUSIONS

The guidlines provided in the statements of the previous paragraphs will be more fully developed and interpreted by senior researchers as they commence their HSRI activities. The following paragraphs, extracted from a communication from Roger C. Cramton, Professor of Law, The University of Michigan, illustrate as an example an interpretation and approach to the questions suggested in Section 5.1.3.

> A Pilot Study: Intentions vs. Results in the Legal Control of Highway Safety—A Study of the Effectiveness of Legal Sanctions in Controlling Driver Behavior and Vehicle Characteristics.
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> Our legal system provides a wide variety of inducements and sanctions for controlling human conduct. A great many of these techniques are applied in the highway safety field in a purposive effort to control driver behavior and vehicle characteristics. We know very little, however, about the relative effectiveness of various sanctions in controlling human behavior. The problem is a general one; but the highway safety field is an important and favorable one for special attention.
>
> The starting point would be a detailed examination of the sanctions and regulations which are intended to promote highway safety in Michigan

and a few other major states. After this survey of legal standards, the next step would be a preliminary study of the behavior of officials who administer these laws. For example, how does the driver licensing and license revocation system work in practice? What are its costs and difficulties? Does it have any perceptible influence on driver selection and behavior? After a descriptive and largely non-quantitative study of enforcement standards and techniques, we would be prepared, hopefully, to suggest fruitful avenues for a more scientific examination of the problem. The subsequent study would be quantitative and interdisciplinary in character.

Although attention would be given to individual sanctions, such as license revocation and vehicle inspection, the entire system of sanctions should be surveyed, with particular stress upon their relationship one to another.

7. PROGRAM PRIORITIES

A broad plan of program priorities needs yet to be fully developed. HSRI now has a group of faculty consultants (S. Bonder, D. Cleveland, and D. Wilson) at work developing an analysis of the problem area from which a research strategy may be determined. Completion of the effort, however, presupposes that the individual skills and abilities of experts from many disciplines can be effectively brought to bear on the problem areas defined. The specific interpretations of the many areas indicated in previous sections must ultimately be made by individual researchers, and even these interpretations may often be sketchy and incomplete for many months after these people become engaged.

It seems clear that to attain the comprehensive multidisciplinary stature hoped for, we must begin with a nucleus of senior staff researchers.* We must ensure that each candidate is sincerely interested in sharing the rationale of his approach, his objectives, and his findings with the University at large and in such a way as to directly benefit the entire HSRI program. Thus each

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*While several of the research needs can best be satisfied by present members of the University staff, a need exists to augment this staff with new specialists and a core of full-time researchers. These people may be appointed directly within HSRI or with joint HSRI-teaching departmental appointments.

staff member would be expected to feed his specific expertise into the research strategy, and to pay close attention to developments in others' areas of interest to determine when and how collaboration might be indicated.

Priorities among the subareas indicated may be established most efficiently by controlling the relative sizes and resources of the teams led by the key researchers. Thus, for many months to come, we should be reluctant to assign budgets of effort to the various areas, but should vigorously recruit a nucleus of senior research staff members.

Each of the major subareas listed in this report will require the attention of at least one half-time staff member, and several require a minimum of one full-time member. Each researcher will very soon establish his own needs for associates, assistants, and equipment. We must recommend that these needs be fully documented and studied by the executive group before enlarging beyond the original levels.