U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
NATIONAL HIGHWAY SAFETY BUREAU
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SOME TRENDS AND VIEWS ON NEW CAR AND USED CAR SAFETY PERFORMANCE STANDARDS

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Remarks Prepared for Delivery Before
Detroit Section, Regional Meeting
Society of Automotive Engineers
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Fellow engineers. Fellow members of the Society of Automotive Engineers.

It is indeed a pleasure to meet with you tonight to discuss and exchange views on the safety of motor vehicles --- not only when they leave the showroom floor, but also years later when, after having gone through a succession of owners, they are in a poor state of repair, even long overdue for the junkyard, but continue in use on public thoroughfares.

My remarks are concerned no less with the fact that when these very old vehicles continue in use on public thoroughfares, their owners, typically from lower income groups of our society, can neither afford expensive repairs nor the price of replacement vehicles.

And, in the absence of adequate, low cost public transportation, what are their alternatives -----

. To shop

. To get to a movie, or a ball game?

. To visit family or friends?

. In short, to enjoy life?

While I, as an engineer, speak to you as fellow engineers on engineering matters, we cannot forget those broader sociological values that transcend the nuts and bolts of classical engineering practice. We are discussing materials and practices with implications that cannot ever be reduced to slide-rule accuracy --- life, health, and the sociological value systems of living in modern civilization. In this regard I would like to read the following quotation:

> "We should not expect ever to employ in practice all the motive power of the combustibles used. The efforts which one would make to attain this result would be even more harmful than useful if they led to the neglect of other important considerations. The economy of fuel is only one of the conditions which should be fulfilled by steam engines; in many cases it is only a secondary consideration. It must often yield the precedence to safety, to the solidity and durability of the engine, to the space it must occupy, to the cost of its construction, etc. To be able to appreciate justly in each case the considerations of convenience

and economy which present themselves, to be able to recognize the most important from those which are only subordinate, to adjust them all suitably, and finally to reach the best results by the easiest method -- such should be the power of the man who is called on to direct and coordinate the labors of his fellow men, and to make them concur in attaining a useful purpose."

A quotation of this sort could readily have come as a part of the extensive legislative history that preceded the enactment of Federal safety laws. It could have come from any of the millions of words of safety pronouncements that lead up to the passage of highway safety legislation.

The fact of the matter is that it did not. It is the last paragraph of the monumental treatise on the second law of thermodynamics published in 1852 by one of the great engineers of all time, Carnot.

This regard of the engineer for safety can readily be shown to have been of concern not only to Carnot, but many of the other great engineers, in effect being handed down as a heritage of the profession. The concept is no less evident today in the various important documents of the profession. For example, the Canons of Ethics promulgated by the Engineers' Council for Professional Development states:

"(1) The engineer 'will have due regard for the safety of life and health of the public and employees who may be affected by the work for which he is responsible.'

"(2) He will guard against conditions that are dangerous or threatening to life, limb, or property on work for which he is responsible, or if he is not responsible, will promptly call such conditions to the attention of those who are responsible.' "

It would be idle and foolish to assert that the engineering profession has not produced safe cars. In November 1966, shortly after the passage of the safety laws, I made the following statement:

"We do not question the fact that cars today include, on overall balance, much safer design concepts than ever before. But the overwhelming evidence is that the promotion of motor vehicle safety through voluntary standards has not produced a degree of safety anywhere near levels that are well within our present technology. In other words, many of our most recent major scientific breakthroughs remain to be incorporated in vehicle design for greater safety."

Since then we have seen introduced into the vehicles sold to the American public such important safety features as the energy-absorbing steering shaft. The initial experience with it has been truly spectacular. We believe that it will prove to be one of the important breakthroughs in vehicle safety and undoubtedly it is a major engineering achievement.

But the motoring public cannot help but ask the engineering profession the very embarrassing question of why it took so long for these lifesaving features to be incorporated into vehicles.

Progress in safety is possible.

More specifically, progress in vehicle safety has unmistakably been called for by President Johnson, mandated by the Congress and, I believe, demanded by the motoring public.

Let me briefly review four aspects of the new national effort spearheaded by the Department of Transportation to achieve greater safety performance in motor vehicles:

(1) The development and application of new car safety performance standards -- these are standards that are applied to new cars before they may be sold to the public.

(2) The development and application of used car safety performance standards -- these are standards that are applied to vehicles once they are in operation on our Nation's highways.

(3) The improvement and standardization of motor vehicle inspection programs. and

(4) Comprehensive engineering and economic studies to guide both the application and development of the

standards themselves, and to guide the effective allocation of economic resources.

Within this 4-point program certain goals have already been achieved while others are in the process of implementation.

For example: The National Traffic and Motor Vehicle Safety Act of 1966 directed the Secretary of Transportation to issue safety standards for new vehicles. To date, 23 such standards have been issued.

In addition, this same Act directed the Secretary of Transportation to issue safety standards for used motor vehicles. Under law, these initial Federal standards for the safety performance of used vehicles are to be issued by Fall of this year. These standards are presently under development in the National Highway Safety Bureau, and will attempt to cover those vehicle components and systems which simultaneously have an obvious impact on safety performance and are subject to deterioration through vehicle usage. The areas which are under consideration include brakes, steering, suspension, tires, lighting, as well as occupant restraint devices, windshield washing and wiping, glazing, and other vehicle components and systems.

The third area of concentration under this 4-point vehicle safety performance program is that of motor vehicle inspection. An initial standard for State motor vehicle inspection programs has been issued by the Department of Transportation. The purpose of this initial standard

is to induce the States to improve and standardize their basic programs of enforcing vehicle safety. The standard establishes the basis for a national program of quality, periodic motor vehicle inspection. This standard was issued in June of 1967, and a number of States have subsequently established legislation which enables them to comply. Thirty-two States now have such programs. State motor vehicle inspection programs must serve as the foundation for the effective implementation os used car standards.

It may be noted that approximately 80 percent of the vehicles in the country are in States which have motor vehicle inspection statutes -- although all of these do not require periodic motor vehicle inspection of all vehicles. Under the Highway Safety Act of 1966, a number of States have already utilized the Federal grant-in-aid program to upgrade and expand their motor vehicle inspection programs. It is expected that many other States will take similar steps in the near future.

The last category of the 4-point program deals with the technical, economic and administrative studies necessary to properly direct the development of future standards and the allocation of national economic resources. To achieve this goal, an intensive and broadly based research program was launched last year. Approximately 70 research contracts have been placed with private industry, universities and public research institutions. A substantial number of these projects deal

specifically with the development of standards for new vehicles, used vehicles, and motor vehicle inspection. An increasing research emphasis will be placed on these particular areas in the future.

While discussing vehicle safety standards, it is convenient to make a distinction between new car standards -- standards applied at time of manufacture -- and used car standards -- standards applied to the vehicle once it is in operation. However, it must be recognized that the new car standards are of value only if they improve the safety quality of the vehicle in use. For this reason, both new car and used car standards share the same ultimate goal.

Thus, although we may talk about new car standards on the one hand and used car standards on the other hand, we must keep sight of the fact that they both only have meaning in terms of the vehicle which is being used.

Furthermore, it is not possible to isolate the technical and economic considerations involved in used car standards, new car standards, and motor vehicle inspection.

Certain types of vehicle safety properties can only be treated as standards to be applied to new vehicles. Examples include the energy-absorbing steering column, structural crashworthiness, the padded dashboard, and similar components. In many cases these same components are not likely candidates for used car standards since the deterioration in their safety performance over time is not substantial.

On the other hand, braking, steering, lighting, wheel alignment, and suspension are among the candidates for used vehicle safety standards. This is because their safety performance is known to deteriorate with use.

Nevertheless, new car standards must also have an important future role in terms of those vehicle systems and components that deteriorate with use. There is no doubt that vehicles should be designed and manufactured in such a way as to assure that those components and systems that have a critical relationship to safe performance have a high degree of reliability over extended periods of time. It is clear that the safety condition of certain vehicle components may be much more effectively achieved through the original design and manufacture than through frequent vehicle inspection.

For this reason, certain areas of used car standards as well as motor vehicle inspection requirements may be relaxed if component and system reliability is guaranteed in the new vehicle. The economics of this well known reliability/maintenance tradeoff strongly suggest that future new car standards will tend to deal with the safety reliability of the vehicle as well as the simple existence of safety features in the new car.

An additional consideration in future new car standards lies in the design and manufacture of safety related components and systems in such a way as to facilitate their safe repair and maintenance. It is unfortunate that repair practices occasionally introduce much more serious safety defects than they attempt to correct. Although this situation may be traced to carelessness, it may also be attributed -- in some cases -- to an inherent difficulty in making the repair -- and this is a vehicle design feature.

Although new vehicle safety standards which emphasize reliability and maintainability cannot eliminate the need for used car standards, they can reduce the frequency with which the vehicle must be inspected. This has considerable practical relevance in terms of both cost and convenience.

In essence, new car standards must be treated, collectively, with used car standards and standards for motor vehicle inspection. They must be viewed as part of a system whose goal is to achieve the most economical means of achieving improved safety quality of the vehicle in use. Future new car standards will reflect this philosophy.

The used car standards must satisfy a number of requirements which are not found in new car standards. As with those for the new car, the used car standards must be performance oriented and practical.

There are, however, constraints on the application of used car standards which do not exist for their new car counterparts.

While compliance with new motor vehicle safety standards rests with a limited number of manufacturers, compliance under used motor vehicle safety standards rests with the millions of vehicle owners under the jurisdiction of State motor vehicle inspection. Further, this compliance is dependent on maintenance and repair practices in garages and service stations throughout the country.

Since the mechanism for the enforcement of used car standards lies in motor vehicle inspection, the standards must translate into practical test procedures. Furthermore, the test procedures themselves must be practical in terms of the periodic inspection of a used vehicle population of 100,000,000 and which is rapidly increasing.

This may be reduced to several specific technical questions:

- What is the nature and magnitude of the specific test equipment that will be required to support the used car standards under motor vehicle inspection?

- What is the number of inspection facilities that will be required and what will be their production capability?

- What are the personnel requirements in terms of both numbers and skill levels?

Although specific answers are not presently available to all of these questions, there is considerable evidence to suggest that both the sophistication of motor vehicle inspection hardware and of the inspection personnel will increase in response to the used car safety standards.

In the selection of specific standards from among the candidates for used motor vehicle safety standards consideration must be given to the safety criticality of the candidate item as well as to its associated inspection cost and repair cost.

For example, embrittlement of a part can be detected by x-ray and other industrial methods. Even so, it is unlikely that such a practice for routine inspection of used vehicles would be a prudent investment in terms of safety payoff.

In addition to components and systems subject to deterioration, some used car standards will be addressed to insuring the existence of certain safety related components in the vehicle. In such cases the decision must be made as to whether the standard should be applied to all vehicles regardless of age. Most States have traditionally handled this problem by applying grandfather clauses under which vehicles manufactured before a specific date are exempted.

Differences between jurisdictions have led to the situation in which a vehicle is able to comply with standards in one State but fails to comply with standards in an adjacent State which requires the safety item to be retrofitted to the older vehicles. The newly effective Federal safety standards for new vehicles provide some examples. In some cases, such as the energy-absorbing steering column, retrofit is virtually impossible. For others, such as side view mirrors, add-on is comparatively simple. The Federal standards will provide national consistency to the requirements for safety standards on used vehicles.

Any requirement for retrofit or add-on must be carefully considered. In addition to the feasibility of retrofit or add-on, consideration must be given to the effect of imposing an expense which will be particularly felt among the low income groups, who drive a larger relative percentage of the older vehicles. The cost to such owners of altering their vehicles, or disposing of them if a change is substantial, must be balanced against the probability of the occurrence and severity of accident that might result if the change were not made.

These are only some of the considerations that will influence the future trends in both used car and new car standards.

Permit me now to comment briefly on the closely related area of motor vehicle inspection.

It is clear that the success of vehicle inspection depends on the efficiency and reliability of both the technical and administrative aspects of the program. The principal technical considerations include the items to be inspected, the methods and equipment employed in performing the inspection, as well as the interval between subsequent inspections.

The administrative considerations are just as important and include matters such as whether the inspection will be performed by State-owned and operated inspection stations, by private garages licensed by the State, or by a combination of both of these. Other principal administrative functions include the enforcement procedures to ensure that defective vehicles are repaired and that the prescribed standards and procedures are accurately and honestly implemented by the inspection stations.

Generally speaking, Federal standards related to State motor vehicle inspection will deal primarily with the technical aspects of the program, although guidelines will be issued covering all aspects.

It should be noted that a national program of motor vehicle inspection has additional potential benefits. For example:

- The Periodic Motor Vehicle Inspection Standard issued by the Department of Transportation last year requires the States to collect and publish data on

safety defects by make and model of vehicle. This will provide an invaluable tool for detecting patterns of safety deficiencies and for informing the public of their existence. It will also assist in the discovery of safety defects early in the life of the vehicle.

- Under the National Traffic and Motor Vehicle Safety Act of 1966, motor vehicle manufacturers are required to advise the Secretary of Transportation of vehicle recall campaigns to correct safety defects, and to inform him of the nature of the corrective action which is taken. Periodic inspection of all vehicles may be used to assure that vehicle owners respond to the recall campaign and that corrections are made.
- As mentioned earlier, future new car standards will emphasize the reliability aspects of safety related components and systems. The ultimate test of this reliability must be in terms of the actual operating characteristics of the vehicle as it is found in normal use on our nation's highways. Motor vehicle inspection

may thus become the principal mechanism for obtaining the data needed to determine the effectiveness of the vehicle design and manufacture in meeting long-term reliability requirements.

A first step in the establishment of overall goals for vehicle safety performance is an accurate assessment of the safety quality of the used motor vehicle population against used vehicle standards. When this is accomplished, it will be possible to state short- and long-term goals in terms of the percentage of vehicles on the road which are defective in some critical safety area. If present motor vehicle inspection statistics are used, it could be estimated that on the order of 50 percent of the vehicles on the road today are deficient in at least one important safety aspect. A reduction in this percentage through new car, used car, and motor vehicle inspection standards is an immediate goal of the Department of Transportation.

There are several technical tasks that are of considerable importance in the development of used car standards and future new car standards and for the development of standards for motor vehicle inspection. It is essential that we obtain a vastly improved understanding of the way in which vehicles deteriorate and the safety implications of this deterioration.

Two specific technical tasks can be identified. The first is an improved understanding of the probability of component failure as a function of vehicle use and time. The second involves the crash implications if the component or system has failed or is in a degraded condition. The improvement of our understanding of these processes may be simultaneously undertaken in several ways. These include the detailed investigations of actual vehicle crashes, experimentation, and the analysis of data which exists from manufacturer engineering analyses and warranty programs. Such investigations and studies must accompany the development of future standards for new cars, used cars, and for improved motor vehicle inspection.

In conclusion, it is clear that future trends in vehicle performance standards will be influenced by a number of technical and economic considerations. It is also clear that future developments in vehicle performance standards must be accompanied by a substantial technical and economic research effort.

To achieve maximum effectiveness, the programs of used car standards, new car standards, and standards for motor vehicle inspection must be approached under a unified concept of vehicle-in-use safety performance. All possible tradeoffs between these three standards areas must be utilized to achieve the most effective possible strategy.

The reduction of death and injury on our nation's highways poses a specific challenge to many private and public sectors of our nation. The continued effort of the Society of Automotive Engineers to meet this challenge is not only essential, it is its responsibility as part of a historic transition of the engineering profession.

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SAFETY GOALS FOR THE YEARS AHEAD

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National Highway Safety Bureau

Remarks Prepared for Delivery Before
Bendix Management Club
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One of the biggest obstacles to progress in motor vehicle and highway safety has been the unpleasantness of the problem. People have been unwilling to face the shocking truth of the statistics which document the carnage on our roads; they have preferred to think it cannot happen to them.

A nation that is used to regarding itself, as well as being regarded by others, as the wealthiest, the most progressive and the most technologically advanced country in the world looks away from violence. In a recent attempt to put into perspective the brutal facts of assassination of national leaders, riots in our cities and crime in the streets, a leading American newspaper asked a cross section of learned people, "Is America by nature a violent society?" One respondent, a prominent social psychologist, noted that the homicide rate in the United States is five times that of other developed countries; only two countries--both undeveloped--have higher rates. Yet overlooked in this perspective was the tragedy of death and injury on the roads.

Like it or not, it is fact that in the age group from 15 to 24 the number of motor vehicle deaths exceeds the combined total of the next

five causes of death for this age group, including such other well-known results of violence as other accidents, homicides and suicides. Vehicle crashes are the most common cause of death from 15 to 35 years of age in the United States and are among the first three causes of death for all other ages between the first year of life and middle age.

The figures in totality are no less shocking: 13.5 million motor vehicle accidents in 1967, accounting for over 52,000 deaths and 3,535,000 serious injuries. The loss is not all human, either; the National Safety Council estimates the economic loss from highway crashes exceeds $10 billion a year, counting only property damage and the costs associated with the millions of injuries sustained each year. As another measure there is the loss of future earnings by those killed, which approaches $5 billion annually.

To state the problem is to pose the solution. Given the cruel dimensions of the highway safety problem, is it little wonder that the national goal stated by the Congress and the President in the enactment of the safety legislation two years ago is "to reduce traffic accidents and death and injuries to persons resulting from traffic accidents?"

We should not be in doubt about what our goals in vehicle and highway safety are, if goals are defined as ultimate objectives. More pressing are the questions of how we are to reach the goals, in which time frame and in what order of priority. I should say at the outset that I do not throw out those questions rhetorically. Although I will describe briefly our current and projected plan of attack of the highway safety problem in the National Highway Safety Bureau, I would not want

it thought that we in Washington believe that we know all or even enough of the answers to those questions. Instead, my aim would be to stimulate and encourage a continying dialogue on these questions.

Our first task was to build a conceptual framework by identifying the components of the problem and the opportunities each presents to the goal of diminishing the human and economic losses. This framework has been stated in terms of a systems approach in which the principal parts of the problem are: the pre-crash phase, the crash phase, and the post-crash phase.

In the pre-crash phase are included the circumstances--such as drunken driving, blowouts and the shortcomings of highways--that increase the likelihood that crashes will take place.

In the crash phase are the circumstances that determine whether injuries will be sustained in the event of a crash and, if so, their nature and severity. These circumstances include the exterior and interior design of the car for protection of occupants and pedestrians, that is to say, the car's crashworthiness.

In the post-crash phase are the circumstances--such as the quality and rapidity of emergency response services--that determine the likelihood of the survival of those injured in a crash.

It was within this framework that the Bureau has acted to meet the statutory and other requirements which have dictated the initial priorities and time scale. In the first 18 months of the Bureau's existence a total of 22 initial motor vehicle safety performance standards were issued covering the current 1968 models as well as future production.

In addition, six new standards or amendments to standards have been issued to apply to vehicles manufactured after December 31, 1968, and one becomes effective January 1, 1970. In various steps of the legal process we must follow in setting vehicle standards, there are also 21 proposed new standards and 20 amendments to existing standards.

The numbering system of these standards corresponds to the safety problem phases of the counter-measure systems framework. For instance, standard 105 on braking systems relates to circumstances which cause crashes; standard 208, requiring lap and upper torso restraint belts in each front outboard seat position, provides occupant protection to obviate or minimize the injuries sustained in the event of crash; and standard 301 on fuel tanks reduces the fire hazards after collision or crash.

Other deadlines imposed by the National Traffic and Motor Vehicle Safety Act of 1966 require that the Secretary of Transportation establish by this fall uniform Federal motor vehicle safety standards applicable to all used motor vehicles and a uniform quality grading system for motor vehicle tires.

We have also acted in response to the requirements of the companion piece of safety legislation, the Highway Safety Act of 1966. Under this authority the Secretary has issued to the States uniform standards covering such areas as improved highway design and maintenance, motor vehicle inspection, driver education, accident investigation and record systems, and emergency services. These standards form the base upon which the States are building comprehensive highway safety programs. Continued progress in the States is encouraged by Federal grant-in-aid funds.

How do these initial requirements and standards relate specifically to the overall goal of reducing accidents and the deaths and injuries associated with them?

The basic criteria which has guided the Bureau in shaping the specific substantive content of initial standards is the likelihood of immediate payoff in reducing the loss of life, limb and property. The research and other information available to the Bureau indicated that there were a large number of safety actions which could be taken either at the manufacturing level with respect to vehicles and vehicle equipment or at the State and community level with respect to driver and highway environment programs. Further selection for standards depended on the interaction of two other factors: one, the relationship of the action to an aspect of crash and casualty reduction and, two, the time, effort and cost required to implement the action. This process can be described as the application of cost effectiveness judgments.

For instance, in the vehicle area the value of safety belts that restrain both the pelvis and the upper torso received impressive documentation on the basis of scientific studies of actual crashes reported during 1967. This work, carried out in Sweden and immediately made available for Bureau use, revealed that the injury-reducing effect of restraints of this type was about 30 percent for minor injuries and 80 percent for those of fatal grade. The Swedish work showed that non-belted vehicle occupants in the 28,000 crashes studied sustained fatal injuries beginning at speeds of 12 miles per hour and higher, whereas at crash speeds below 60 miles per hour none of the belted occupants was fatally injured.

In the State and community area medical authorities estimate that between 10,000 and 20,000 of those who die as a result of highway crashes might be saved if systems of post-crash emergency response were in operation throughout the United States.

These are only two examples of the kind of reasoning applied to the selection of standards.

Since the issuance of the standards what can be said of their effectiveness, again as related to the ultimate goals of the program?

On another occasion I pointed out that safety per se is not measurable, but "nonsafety" or the crash, on the other hand, is measurable. That is to say, we can with various investigative and statistical tools measure the effect of safety standards on the incidence of death and injury. The degree to which we can do this at present leaves much to be desired. Our present crash information systems fall far short of yielding data with the precision desired.

For the most part, the best that can be done at present is to argue from inference that safety standards do have a payoff. For instance, one of the State and community safety program standards provides for requirements that motorcycle drivers and passengers wear approved crash helmets. Despite a continued increase in motorcycle registration, there has been an overall reduction of 27 percent in the motorcycle death rate in those States requiring such helmets. The largest decrease was in New York, where motorcycle deaths dropped 42 percent in 1967. By contrast, California, which does not have such a helmet requirement, recorded a 9 percent increase in motorcycle crash deaths in a 10-month period in 1967.

By the same reasoning process, preliminary evidence indicates the possibility of as much as an 80 percent reduction in driver fatalities due to the introduction of the energy-absorbing steering shaft assembly. Only the 1968 models are required by Federal standards to have this feature, although it was present in some 1967 models. Thus it will be almost 10 years before most of the present vehicles without this life-saving feature will be off the roads. By then the full impact of this initial Federal vehicle safety standard will be recognized.

Much better information, as well as better information gathering procedures, are needed before we can assess the respective values of individual standards and other safety program elements in relation to their costs. Toward this end, the Bureau has recently initiated two important contract projects. In one project, the University of California at Los Angeles will develop a systematic, scientific body of knowledge on the causes of accidents and their associated casualties, and will devise guidelines for weighing the value and cost of vehicle safety activities. The project will use an interdisciplinary team approach, including vehicle experimentation and on-scene accident investigation by physicians, engineers and other researchers. A second project is a contract with the State of New York under which the State will document a range of information on 27 makes of automobiles, foreign and domestic, involved in crashes in the State over a 2-year period.

Similar make and model information on the results of motor vehicle inspection in the States will be developed by the Bureau in much the same way as currently done in Sweden.

These projects illustrate the objective of the Federal safety program to engage the talents of those outside Government, such as in industry, the States, the academic community, and the public at large. For instance, the work at UCLA has been sponsored by the Automobile Manufacturers Association as well as by the Federal Government.

If the safety program is to be a truly national one, the role of the private and other sectors must be a strong one. It is both a matter of self-interest and national interest to participate in this program since its impact on our society will be as pervasive as that of the automobile itself. Such participation includes the shaping of safety goals for the years ahead by this audience as an industry and as concerned drivers and citizens.

I would refer again to the safety dialogue which I mentioned earlier. Let me say first what ought not to constitute this dialogue. It ought not be restricted to responses to proposed standards in which arguments are offered only against a particular Federal standard. It ought not concentrate on outmoded concepts of vehicle and highway safety which are not aimed at the reduction of fatalities, injuries and other losses. It ought not try to turn back the clock to one-sided or limited approaches to the problem, such as characterized the past emphasis on the driver or other "single bullet" solutions to the problem.

There are many encouraging signs that a different and productive dialogue is beginning. In industry, for instance, there are reports that next year's model automobile will incorporate devices initiated by industry

itself, such as side strengthening for intrusion protection, rear window defroster-defogger units, and electronic speed control systems. We are particularly eager to see the implementation of the pioneering work being done here on the so-called anti-skid braking feature.

The vehicle defect recall campaigns, accelerated by the safety legislation, also have put a new emphasis on quality control, not only at the vehicle manufacturing level but, more importantly, also at the vendor level.

The future expansion of the equipment safety area offers unique opportunities to this audience particularly. There is no reason for industry to wait for the Federal Government to move in this area. The proposals should be going to Washington as well as vice versa.

Of even greater interest to this audience, however, is the question of increased safety for vehicles in use. To date the Bureau has concentrated on standards for newly manufactured or imported motor vehicles. Under the National Traffic and Motor Vehicle Safety Act of 1966 the Bureau also has the responsibility, and I might say the requirement, to establish uniform safety performance standards applicable to all used motor vehicles.

Under law, these initial Federal standards for the safety performance of used vehicles are to be issued by Fall of this year. These standards are presently under development in the National Highway Safety Bureau, and will attempt to cover those vehicle components and systems which simultaneously have an obvious impact on safety performance and are subject to deterioration through vehicle usage. Some examples are:

brakes, steering, suspension, tires, lighting, as well as occupant restraint devices, windshield washing and wiping, glazing, and other vehicle components and systems.

Directly related to this program is the subject of motor vehicle inspection. An initial standard for State motor vehicle inspection programs has been issued by the Department of Transportation. The purpose of this initial standard is to induce each State to improve and standardize its basic program of assuring that all vehicles in operation on public thoroughfares are in reasonably safe working order. The standard, establishing the basis for a national program of quality, periodic motor vehicle inspection, was issued in June of 1967. A number of States have subsequently enacted legislation enabling them to comply. Thirty-two States now have such programs. State motor vehicle inspection programs must serve as the foundation for the effective implementation of used car standards.

It may be noted that approximately 80 percent of the vehicles in the country are in States which have motor vehicle inspection statutes--although all of these do not require periodic motor vehicle inspection of all vehicles. Under the Highway Safety Act of 1966, a number of States have already utilized the Federal grant-in-aid program to upgrade and expand their motor vehicle inspection programs. It is expected that many other States will take similar steps in the near future.

While discussing vehicle safety standards, it is convenient to make a distinction between new car standards--standards applied at time of manufacture--and used car standards--standards applied to the vehicle once it is in operation. However, it must be recognized that the new

car standards are of value only if they improve the safety quality of the vehicle in use. For this reason, both new car and used car standards share the same ultimate goal.

Furthermore, it frequently is not possible to isolate the technical and economic considerations involved in used car standards, new car standards, and motor vehicle inspection.

Certain types of vehicle safety properties can only be treated as standards to be applied to new vehicles. Examples include the energy-absorbing steering column, structural crashworthiness, the padded dashboard, and similar components. In many cases these same components are not likely candidates for used car standards since the deterioration in their safety performance over time is not substantial.

On the other hand, braking, steering, lighting, wheel alignment, and suspension are among the candidates for used vehicle safety standards because their safety performance is known to deteriorate with use.

Nevertheless, new car standards must also have an important future role in terms of those vehicle systems and components that deteriorate with use. There is no doubt that vehicles should be designed and manufactured in such a way as to assure that those components and systems that have a critical relationship to safe performance have a high degree of reliability over extended periods of time. It is clear that the safety condition of certain vehicle components may be much more effectively achieved through the original design and manufacture than through frequent vehicle inspection.

For this reason, certain areas of used car standards as well as motor vehicle inspection requirements may be relaxed if component and

system reliability is guaranteed in the new vehicle. The economics of this well-known reliability/maintenance tradeoff strongly suggest that future new car standards will tend to deal with the safety reliability of the vehicle as well as the simple existence of safety features in the new car.

An additional consideration in future new car standards lies in the design and manufacture of safety related components and systems in such a way as to facilitate their safe repair and maintenance. It is unfortunate that repair practices occasionally can introduce much more serious safety defects than they attempt to correct. Although this situation may be traced to carelessness, it may also be attributed--in some cases--to an inherent difficulty in making the repair--and this is a vehicle design feature.

This evening I have talked about what might best be described as program goals. Let me recapitulate them in terms of Federal Government actions:

--Improve the safety performance of motor vehicles and motor vehicle equipment.

--Assure proper safety quality of vehicles in use.

--Assist the States and local governments in expanding and improving their highway safety programs.

--Improve the process of highway accident investigation, vehicle damage and injury assessment, and information analysis.

I leave to you to rephrase these or translate them in terms of your own actions. As I said at the outset, I do not think the overall goal of reducing accidents--or as we prefer to say, crashes--and their

associated fatalities, injuries and other losses is at question or in doubt. The questions instead are ones we share, those of selecting actions to meet this goal, of fixing priorities and perhaps of setting our own deadlines.

I would not leave you with the impression that these are easy questions. They involve such complex issues as production lead time, predictability of research, engineering scheduling, statistical measurement, product design, consumer economics, manpower training, crash investigation, and on through the list.

Directly related to these issues and central to the question of goals is the more baffling problem of quantifying and measuring progress. Can we translate the goal of reducing fatalities and injuries to numerical figures? Can specific casualty reduction figures be assigned to various individual safety standards? Shall these figures be related to a definite time scale? Will cost effectiveness tools be devised to determine the choice of safety actions?

The broad policy implications of setting goals are no less difficult to handle than are the technical issues. For this reason, we seek a wide range of advice and help on this problem. For instance, currently wrestling with it is the National Motor Vehicle Safety Advisory Council. This is an appropriate subject for a group established by the Traffic Safety Act to represent before the Secretary of Transportation the public, the States, and industry, including the equipment industry.

I urge you to join in this search. No one can say yet when we will reach a reasonable level of safety in our vehicles and on our roads,

but this day will come only if there is a concerted and imaginative effort of all concerned with the problem.

With the odds currently at one in three of us joining the statistics of those seriously injured or killed in an automobile accident, we should need no other incentive.

SOME VIEWS ON MOTOR VEHICLE AND HIGHWAY SAFETY

Robert Brenner
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Remarks Prepared for Delivery Before
Recreational Vehicle Institute
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Chicago

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It is a pleasure to be here today to exchange ideas on motor vehicle and highway safety with you, the leaders of our nation's important recreational vehicle industry.

Yours is a growing industry, as shown by market forecasts, polls, industry surveys, and all other indicators. The American Automobile Association predicts that American families will spend about 32 billion dollars on domestic vacation and pleasure travel in 1968. A total of 105 million people will roll up 195 billion miles on U. S. highways on trips for recreational purposes.

Even more recreational travel is in prospect as the work week is shortened. The Congress has now enacted legislation calling for five official 3-day weekends each year, and with more long weekends together with longer paid vacations, families will expand the frequency and distance of recreational trips greatly.

The population estimate for the year 2000 is 350 million. The gross national product estimate for the year 2000 is $2,000

trillion. Disposable income is projected to rise to $1,437 billion at the turn of the century.

Population and leisure time growth, combined with increasing per capita travel and income will result in a continuing upward trend in the recreation field. All indicators point up as to the amount of recreational travel; the future of your industry is most favorable.

But there are other indicators as well, and these do not make pleasant reading. Unless present upward trends in highway traffic fatalities are checked, today's rate of about 53,000 deaths per year will rise to 100,000 deaths a year by the year 2000.

And, there are some accident research data that are of even more direct relevance to the recreational vehicle industry. In particular, one study of accident experience on turnpikes reveals that vehicles hauling utility and house trailers were involved in 2.7 times as many accidents as passenger cars based on their relative vehicle miles of exposure.[1] The trailer group has the dubious distinction of being among the most unsafe vehicle combinations traveling the turnpikes.

Thus, even while the demand for recreational travel is skyrocketing, the recreational vehicle industry must also face these most disturbing yet unmistakable indications of unusually high accident involvement of at least one important category of recreational vehicle.

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[1] Crosby, J. R. "Accident Experience on the New Jersey Turnpike," Traffic Engr., February 959. pp 18-23, 34

However, I do not wish to single out the recreational vehicle, for the problem of national importance involves all types of vehicles and the skills of the drivers who handle them. If the problem is to be dealt with properly, it will require the active participation of all sectors: Federal, State and local governments, universities and foundations, and private industry. But in the final analysis, it will require the interest and support of the individual citizen.

Stated otherwise, the need is for a national effort.

And the foundation for such an effort now exists in the landmark safety legislation, called for by President Johnson and enacted by the Congress unanimously in September 1966. These are the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966. Together, they authorize the Secretary of Transportation to implement the most comprehensive highway traffic safety program in history. Within the Department of Transportation, this responsibility is delegated to the National Highway Safety Bureau, a unit of the Federal Highway Administration.

The activities under each of these laws are relevant to your recreational vehicle industry, and I shall presently outline some that are of most immediate interest to you. Before doing so, however, may I describe briefly our perspective of the traffic safety problem, which is somewhat different from that most frequently used in the past.

Our objectives can be described quite simply: to prevent or to lessen the end results of traffic deaths, injuries, and property damage, we must either:

(1) prevent the occurrence of crashes,

(2) increase the survivability in crashes that occur, or

(3) provide more prompt medical attention to injured people and implement other post-crash salvage measures.

In the pre-crash phase, the issues involved are those which determine whether or not a crash takes place. Here, for example, we are concerned with drunken driving, blowouts, defective or inadequate brakes, and other mechanical failures of vehicles. It includes those medical conditions which may lead to incapacitation while driving, and those features of highway design and maintenance, such as lighting and markings, which make it more difficult for the driver to operate his vehicles safety on the highways.

In the second, or crash phase, we are concerned with the circumstances which, during the crash itself, determine whether or not any injury occurs, and if so, its severity. Here, the success of the vehicle package in protecting its occupants is the paramount issue. Also important is the success of the highway designer in providing the safest possible highway crash design of the road, for example, by ensuring that vehicles that do leave the roadway will not hit solid objects that decelerate them so abruptly that occupant survival becomes unlikely.

Once a crash has taken place, we are then concerned with the post-crash phase and the circumstances which determine whether or not those injured will live or die. Here, the principal issues involve the escape from the vehicle, the likelihood of fire, the speed of the post-accident response, and the quality of the aid and medical care.

The need for a comprehensive system approach is unmistakable, and, as I stated before, provisions for such an effort are contained in the two laws.

Under the motor vehicle safety law, the Secretary is directed to issue safety performance standards that are reasonable, practicable, and above all, meet the needs for safety. To date, a total of 26 vehicle standards have been issued, with the initial standard having become effective for vehicles manufactured after January 1, 1968. Work is in process on standards in a number of additional areas; I shall presently discuss these in greater detail.

Another provision of this Act relates to motor vehicle defects. Vehicle manufacturers must notify owners of safety defects and the steps to be taken to remedy the defects. As of May 31, 1968, a total of 5,232,768 vehicles were the subject of defect notification since the passing of the law.

Whereas some of the defect notifications are initiated by the manufacturer, others are prompted by Bureau action. When a

potential safety related defect is called to the attention of the Bureau through an owner complaint letter, a newspaper article, or any other source, the Bureau asks the appropriate manufacturer to formally investigate the situation and provide a report. A total of 35 such requests have been sent since the procedure was formalized in October 1967. One such Information Request (IR-011) was involved in the initiation of the idler arm recall campaign for 479, 470 1965 and 1966 models of one manufacturer. Another involved dealers' installing incorrect replacement parts in the front suspension which could cause the failure of other related suspension components. Still another involved advising dealers now to instruct owners to operate defrosters correctly in air conditioned cars to prevent windshield "flash-fogging" in high humidity regions of the country when the defroster was turned on.

The second safety law is the Highway Safety Act. Whereas the motor vehicle safety law is directed toward the safety performance of motor vehicles per se and is in essence a regulatory program, the Highway Safety Act embodies a program of Federal grant-in-aid assistance to States and local communities to aid them in carrying out increasingly comprehensive safety programs. Under the authority of this law, the Secretary of Transportation last June issued 13 standards for improving and expanding State and local

highway safety programs in such areas of activity as periodic motor vehicle inspection programs, motor vehicle registration, driver licensing and education, motorcycle safety, investigation and surveillance of accident locations, traffic control devices, traffic records, and emergency services for highway crash victims.

The law provides 50-50 matching Federal funds to assist the States and local communities in upgrading their safety programs, with the provision that at least 40 percent of Federal funds provided to the States be spent by local political subdivisions. This highlights the intent of the Congress that safety can and must start at local levels.

The Bureau also maintains a register of persons who have had their operators licenses withdrawn or revoked for more than 6 months. This register is used by States to check whether new license applicants have had their permits revoked or suspended in other States.

Under both the vehicle and highway safety programs, the Bureau engages in a broad-scale program of research and testing designed to obtain basic data on motor vehicles and their performance, on drivers and other factors of the driving environment. To date, we have awarded 210 research and development contracts and safety management studies totaling $25 million. Some payoff is already beginning to appear, although the full benefit of this work still lies ahead since the work is as yet in the early start-up stages.

In all, the Bureau's activities, under the two enabling laws, are organized into five programs. These are:

1.0 Improve safety performance standards of motor vehicles and motor vehicle equipment.

2.0 Assure proper safety quality of vehicles in use.

3.0 Assist States and local governments in expanding and improving their highway safety programs.

4.0 Improve the process of highway accident investigation, vehicle damage and injury assessment, and information analysis.

5.0 Provide program support and facilities.

Time does not permit me to discuss all of these activities today, but I would like to cover at least some of the highlights of the work on vehicle safety performance standards. As I mentioned earlier, thus far we have issued 26 standards. These are applicable mainly to passenger cars because in the limited time available, we believed that passenger cars, in contrast to trucks, comprised the area of greatest need. Apart from the fact that we couldn't handle the workload with our staff, we did not deal with trucks because many were already subject to safety regulations by our sister bureau in the Federal Highway Administration, the Bureau of Motor Carrier Safety, formerly part of the Interstate Commerce Commission.

Future standards will deal more fully with trucks and motor vehicle equipment items.

It should be noted that present standards pertain only to new vehicles manufactured on or after January of this year. This amounts to about 10 percent of the vehicles in operation. We now are working on safety standards for used vehicles, which will cover the other 90 percent. These standards will be concerned with those vehicle components and systems which are subject to deterioration with use and associated degradation of safety performance. The areas which are under consideration include brakes, steering, suspension, tires, lighting, windshield washing and wiping, glazing, and other vehicle components and systems.

Periodic motor vehicle inspection by the States will have to be the primary means for enforcing the used vehicle standards, and thus represents another important program area of the overall national effort. An initial standard for State motor vehicle inspection programs was issued by the Department of Transportation in June of 1967. A number of States have subsequently enacted legislation on motor vehicle inspection. Thirty-two States now have such programs, and we look to a substantial improvement in the substance, accuracy and reliability of inspections.

Returning to the new vehicle standards, 26 standards are in effect at present, 42 proposed new standards or amendments to

existing standards are in the various stages of the rulemaking processes which must be followed before a standard is finally issued. Among those that are related to trucks are:

102 Transmission shift lever sequence, starter interlock, and transmission braking effect

107 Reflecting surfaces

108 Lamps, reflective devices and associated equipment

205 Glazing material

209 Seat belt assemblies

The following standards are effective on January 1, 1969:

103 Windshield defrosting and defogging

104 Windshield wiping and washing systems

112 Headlamp concealment devices

113 Hood latch systems

In the proposal stage, we have the following items which are truck related:

Brakes

Brake lining

Brake hoses

Tires

Tire traction

Retreaded Tires

Rearview mirrors

Control location

Maximum speed control

Radiator caps

Warning devices

Odometers

Bumper height

Bumper effectiveness

Rear ride underguard

Impact protection for the driver from the steering control system

Intrusion

Energy absorption

Seat anchorages

Seat belt installation

Seat belt assembly anchorages

Exterior protrusions

Door locks, latches, and hinges

Fuel tanks

Fire retardant materials

I will not attempt to describe the very detailed processes that we follow before we finally issue a standard, which, as the law states, must be reasonable, practicable, and meet the need for safety. I would like to emphasize, however, that the law provides that every interested party be given a full opportunity to participate and be heard.

I can assure you that this has been our practice in the past, and will continue in the future. Your own Walter Peck, Standards Director, has been a welcome and helpful participant in these meetings. We look forward to continued assistance and expert expression by him of your interests and problems.

In addition to analyzing the broad array of comments we get on each proposed standard, much of our broad program of applied and long-range research is designed to provide the technical foundation for future standards, either for motor vehicle safety performance or safety programs. To mention a few examples:

Post-crash fire prevention

Vehicle interior material inflammability

Hazardous materials spillage

Truck underride protection

Inspection of trucks

Driver licensing

Traffic codes and laws

It is important to note that in shaping the specific substantive content of initial standards, the Bureau adopted among its basic criteria the likelihood of immediate payoff in reducing the loss of life, limb, and property. Even though conclusive, objective, and

reliable scientific information was not available in any substantive amount, it has been possible to identify a large number of high payoff safety actions which could be taken either at the manufacturing level with respect to vehicles and vehicle equipment, or at the State and community level with respect to driver and highway environment programs. These judgments have largely characterized the initial start-up phases of the program.

For instance, the value of safety belts that restrain both the pelvis and the upper torso received impressive documentation on the basis of scientific studies of actual crashes reported during 1967. This work, carried out in Sweden and immediately made available for Bureau use, revealed that the injury-reducing effect of restraints of this type was about 30 percent for minor injuries and 80 percent for those of fatal grade. The Swedish work showed that non-belted vehicle occupants in the 28,000 crashes studied sustained fatal injuries beginning at speeds of 12 miles per hour and higher, whereas at crash speeds below 60 miles per hour none of the belted occupants was fatally injured.

The University of Michigan conducted a study which concluded that 14,000 lives would have been saved and other thousands of bodily injuries would have been diminished through the use of seat belts.

Their research covered fatal auto crashes in the county around Ann Arbor for a 4-year period. Of the 177 killed, 71 could have been saved by using lap-type belts according to the researchers. Projecting this 40 percent factor to the national total of 35,000 killed in cars during 1966, gives the 14,000 lives that would have been saved.

As a consequence of such data that indicate where potential payoffs are great, we have been able to focus our activities more sharply, in this case dealing with the effective use of restraints.

Another area where a substantial payoff in casualty reduction may be seen is in the estimates of medical authorities -- that between 10,000 and 20,000 of those who die as a result of highway crashes might be saved if systems of post-crash emergency response were in operation throughout the United States.

Even more concrete examples of actual progress may be offered. One of the Federal safety program standards calls for States to require that motorcycle drivers and passengers wear approved crash helmets. Despite a continued increase in motorcycle registration, there has been an overall reduction of 27 percent in the motorcycle death rate in those States requiring such helmets. However, California, which has no helmet requirement, showed a 9 percent increase in motorcycle crash deaths in a 10-month period in 1967. In contrast, motorcycle deaths in New York dropped 42 percent.

This is an unequivocal indication of progress, and proof that significant results can be achieved.

The new national effort has been in operation only a very short time, but indications are beginning to appear that breakthroughs in reducing traffic deaths are possible. Maybe it is wishful thinking, but Dr. Haddon, the Director of the National Highway Safety Bureau, and I are now beginning to speculate that upwards of a 60 percent reduction in traffic deaths are realizable.

However, with the realities of establishing standards, the handicap of not having reliable research information comes into increasingly sharper focus. Progress has been made in these start-up phases of the all-out effort(that has been thirty years late in getting started)only because important areas of corrective action have been immediately apparent, albeit long overdue.

As an aside, one may speculate as to whether many of these seemingly self-evident safety corrective actions would have lain dormant were it not for the force of the all-out Federal legislation with back-up funding.

But unmistakably clear is the fact that subjective, best judgment opinions without the backup of hard research data can only carry the program so far. The need for more facts that are scientifically derived already is all-encompassing, and will become even more pronounced as we move into more difficult decision areas.

To bring this into clear focus within the context of your recreational vehicle industry, permit me again to refer to my earlier statement that the accident involvement of the house trailer type of recreational vehicle is almost 3 times higher than passenger vehicles on a mileage basis. To cite one part of the source report:[2]

> ". . . vehicles towing house or utility trailers have the poorest (accident) involvement ratio. The instability of this vehicle combination combined with driver unfamiliarity with the difficulties in handling the combination is probably the primary reason for this high involvement in accidents. . ."

These are not pleasant words for me to recite, or for you to hear. They are not my words, and I have no basis on which to either reject or accept them. But one fact is certain, I cannot ignore them at least as a potential indicator of trouble.

However, a number of derivative questions can be raised that, I submit, can be answered reliably only after careful systematic research has been completed.

> First: What are the physical force fields that cause or contribute to instability of towed vehicles?
>
> Second: Are all combinations of trailer hitch geometrics and designs coupled with various configurations of size-weight trailers equally safe?

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[2] op cit

Third: If, in fact, recreational vehicles are involved in disproportionately high percentages of accidents, to what degree is this due to drivers over-extending their physical capabilities? Driving when over-fatigued? To state it more simply, to what extent does the problem relate to driver skills, the highway, or other factors in addition to safety performance interest in the design and construction of the vehicle?

Fourth: Should drivers who have never handled a heavy trailer in high speed driving be permitted to do so without appropriate training or check-out?

Fifth: What repair and maintenance practices are followed by owners of recreational vehicles? To what extent are substantial repairs possible at increasingly remote recreational sites?

These represent only several of a number of tough questions for which trustworthy answers will not be easily reached without careful, systematic and dispassionate research. Other tough questions can be posed for other aspects of traffic death and injury experience.

We propose to push such research to the fullest extent possible within personnel and budget and other resource limitations. We will

seek conclusive answers to these and other pressing problems while hopefully disposing of many myths in vehicle and highway safety.

This is clearly in the overall national interest; but it is also of immediate interest to you that workable solutions are sought that will provide appripriate levels of safety to the skyrocketing demand for recreational vehicle travel.

This is the goal we share with you, the leaders of our recreational vehicle industry: the preservation of life even as we seek its enrichment through expanded recreational opportunities.

With the help of the recreational vehicle industry, the goal can and will be achieved. Recreational vehicle travel will thereby meet the almost limitless promise it now holds for bettering the quality of living for millions of Americans.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
NATIONAL HIGHWAY SAFETY BUREAU
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ADVANCING HUMAN ECOLOGY THROUGH PROGRESS IN SAFETY RESEARCH

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Remarks Prepared for Delivery Before
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The survival of all organisms on the earth can be traced to an ability to avoid being attacked, withstand being attacked, or out-think the attacker. From the standpoint of the individual organism, anything outside of him is an element of his environment; and it is by withstanding the onslaughts of his environment that the individual survives.

Organisms in nature survive by a variety of protective mechanisms. Some animals, like deer, can leave the scene rapidly; other creatures, like chameleons, can change color so as to be indistinguishable from the background; still others, like the skunk, are able to make attack a good deal less attractive. These animals, as a class, deal with the environment by lessening the likelihood of being attacked. For this class of animals the concept of "attack avoidance" can be applied meaningfully.

A second class of organisms, like the lobster, the crab, the armadillo, and the rhinoceros are protected by a shell or a hide so that an attack, involving forces of sufficient magnitude to cause serious damage to a less-well armored organism of equal size, leaves these particular creatures relatively or completely unhurt. The second class of creatures can be classified as having "attack protection."

A third class of organisms which are much lower phytogenetically is easily detected, cannot run, is not unattractive, and is unarmored. A vivid example of this is the dandelion, whose top can be torn off -- and a new one simple grows back. An earthworm if cut in half will grow two new halves and become two earthworms; the starfish is capable of similar regeneration. This class of organisms is likely and vulnerable to attack, but has what might be aptly termed a post-attack response capability that provides for its survival.

Thus, there are at least three major ways in which organisms can defend themselves against ecological threats. Typically, only one class of protection is available to the organism, but as long as these relationships between the organism and its environment are fairly stable, a comparatively unchanging ecology as it were, the organism has a high probability of surviving. But if the environment should shift markedly or what is more important, more rapidly than it is possible for the organism to adjust to the changes, the survival probability goes down sharply -- witness the buffalo or the whooping crane.

Turning to man we find that he is not equipped with many of the natural protective mechanisms of animals. He cannot run fast enough to avoid many attackers; if attacked, he does not have natural protection; and, if seriously wounded, he is not equipped with regeneration capability. Man can think, however, and has used this capability to great advantage to fabricate or use systems which, in an attack situation, will get him away quickly (as on a horse, a bicycle, an automobile, or an airplane); which will provide him with protection from attack forces (such as animal hides, chain mail , and sheet armor, and the more sophisticated armor of bulletproof vest); and with expert medical capabilities which have progressed from healing by herbs to healing by medicines, to advanced surgery that enables severed limbs to be reattached and deteriorating organs to be replaced.

George Bernard Shaw once said that "the reasonable man attempts to adapt to his environment. The unreasonable man attempts to adapt the environment to himself. Accordingly, all progress is dependent upon the unreasonable man."

Thus, one might say that man survives through a protective mechanism that enables him to operate on, and modify his environment while lower forms of animal life survive by natural capacities to adjust to their environment.

But we must inquire if man's capability to modify his environment outdistances his capabilities to adjust to the environmental changes he produces. If these capabilities match, there is an enrichment of life; if not, there is a form of self-destruction.

One might cite examples in support of either position, although prefacing such views with a recognition that both processes are probably going on together -- enrichment of the living environment while the environment thus enriched is also producing destructive forces. Permit me to use transportation ecology to develop this concept, citing a recently issued report of the Department of Transportation to the Congress.

> "Americans traveled nearly 1.8 trillion passenger miles last year -- an average of about 9,000 miles per person. About 95 percent of that travel is by motor vehicle. Motor vehicles and highways are, in a sense, our mass transportation system.
>
> Nor will our reliance on that system soon diminish. Not only will automobiles in use increase by about 25 percent during the next 10 years, but travel in them will increase by about 40 percent. During the same period, the population will increase at only one half of the rate of automobiles in use and only one third the rate of intercity automobile passenger miles . . . ."

One hardly need recite the benefits that have accrued from this burgeoning transportation capability. Ready access to recreational areas and the associated amenities, previously enjoyed only by a few are now available to millions. With the recently enacted legislation creating 5 official 3-day weekends each year, the value of this transportation capability will increase further.

A more important outcome of modern individual transportation is in its making new job markets available for many, an obvious social necessity in light of reduced manpower requirements resulting from automation and other industrial process advances. Stated otherwise, it is an important element in the broader social purpose of an open society -- one that affords the individual a maximum of choice, including the selection of where he lives in relation to his job.

To digress, I recently attended a seminar on transportation and poverty, and was somewhat surprised to learn that individual transportation, in contrast to mass public transit and other forms of public transportation, possibly offered the key to solving our present vexing problem of providing jobs for urban ghetto residents and other socially disadvantaged. Compared with other transportation systems the motor vehicle is by far the most convenient, and as indicated in that seminar the most important element in producing effective solutions to serious social problems. But it is also the most destructive:

- more than 10,000 injured on an average day
- more than 1,000 killed in an average week
- about $1 billion cost for crashes each month

These tragic losses produced by man's creation of this transportation-environment are concomitants to the remarkable enrichment to living produced by the creation itself.

And we must ask ourselves if the ecological aspects of the situation are worsening. If the population of cars in use increases faster than the networks of roads to handle them are expanded, the inescapable consequence is that the average separation between mutually threatening objects must increase with a concomitant increase in risk.

This risk relates not only to reduced separation in distance, but the time-gap as well. Vehicle speeds are increasing, and we are now beginning to hear more discussions of the so-called "century speeds" -- or 100 mph speed limits. Such speeds undoubtedly will open new areas of development as well as broadened recreational enjoyment. But they also mean that the magnitude of the threat to the individual in this changed environment is also increased because of the higher energy levels involved and quicker response time requirements.

Man is thereby changing the environment. What about his capacities to cope with the changes he is producing. In this regard, certain facts cannot be disputed.

Generations come and go without important changes in human anatomy or physiology. The accurately measured average speeds of the reactions of the human eye and of the human nervous system and of human muscles have not changed by a millisecond since the early days of man. It has always required at least one-fifth of a second for a human eye to initiate activities leading to muscle response after normal stimulation. The early Roman soldier could most certainly respond as rapidly in casting his spear at an enemy's head just as it rose from behind a barrier as can a modern driver alter the course of his automobile at the sudden appearance of another car coming out of a side road in front of him.

Furthermore, the capability of the skull of a modern pedestrian to resist penetration by the front-end ornaments on a car is essentially unchanged from the capability of the Roman's skull to resist penetration of the spear thrown at him by his enemy, a part of the hostile environment of that day.

In most if not all respects related to survival in the transportation or other environments, men have not changed biologically since they were men. But in spite of his unchanging cell complexes and fixed organ systems, man continues to create changing environments such as modern automobile-highway systems involving each year faster, heavier and more complex moving elements, and stationary elements such as the roadways and traffic controls that pose all sorts of new demands -- and threats -- to his essentially unchanging self.

However, man does have the capability to produce additional changes in the heavier, faster, and more complex environments that compensate, at least in part, for his unchanging anatomical structure. He also has the capability to produce changes in his behavioral and motor skills that compensate, at least in part, for his physiological limits. I would like to cite examples in both veins.

One of the vehicle safety performance standards issued by the Department of Transportation under the provisions of the recently enacted, and landmark safety legislation calls for an energy-absorbing steering assembly that will attenuate crash forces on a driver's chest. Another standard calls for improved windshield performance that substantially reduces the likelihood of severe facial lacerations upon impact. In the less than a year that has elapsed since the effective date of these standards, spectacular results have been forthcoming.

Reports are now quite numerous of seemingly miraculous incidents of motorists walking away from high-speed crashes with little more than minor chest bruises or facial cuts. We believe that these will prove to be among the most important breakthroughs in vehicle safety.

But it would be foolish if not utterly naive to treat this engineering achievement as some sort of miraculous intervention of man upon the destructive forces of nature. The capability of the chest of the driver to withstand a spear aimed at him in conventional designs has not changed one iota. Nor has the relative speed of the initial impact of the steering assembly upon the chest changed. The only change has been the direct

application of the most rudimentary principles of protecting man from highly likely hostile forces.

In fact, the principle is so fundamental, the motoring public cannot help but ask the engineering profession the very embarrassing question of why it took so long for these lifesaving features to be incorporated into vehicles.

The issue is the lag in man's compensating for self-created hostile environments -- not his capability to devise the form of the adjustment. I shall presently discuss this ecological lag in more detail.

I witnessed another example of the fact progress in safety is possible several weeks ago at the opening ceremonies of the magnificent new vehicle safety research facility at the General Motors Proving Grounds. A young secretary with no special driver training was asked to drive a standard stock car at fairly high speeds over a curving course laid out on the vast new skid pan. The course was wet, and the vehicle was caused to skid to test her skills at recovery from the impending loss of control situations. She was unable to do so without skidding and lurching out of control, off of the course.

These initial tests were conducted at the start of the opening ceremonies. As the ceremonies proceeded, the secretary drove the car to another part of the field where, the audience could see her being taught by one of the Proving Ground's staff of highly skilled test drivers how to handle a car properly in a skid.

Some 30 minutes later, she returned to the original test course, and successfully handled the car in the same type of dangerous skidding conditions that she previously could not cope with at all. The display was all the more remarkable because the clearly evident skill at vehicle handling had been acquired in less than a half hour of expert instruction.

I might add that I had witnessed similar, although perhaps not as spectacular, displays of the effectiveness of intensive instruction in vehicle handling skills in demonstrations conducted by the Liberty Mutual Insurance Company on an airbase runway in Washington last year.

On the context of this talk, the meaning of these examples is abundantly clear. The hostile environment was unchanged; the same vehicle was being driven over the same tortuous test roadway in the same impending loss-of-control situation. The only change introduced into that ecology was an added increment of skill in the individual to cope with its demands.

The title of my talk is "Advancing Human Ecology Through Progress in Safety Research". We all can readily cite many examples of safety research that, in fact, has advanced human ecology. I, for one, can describe many of the research efforts that we are sponsoring, and which comprise by far the most extensive all-out safety research program in history. We have attracted some of our nation's best industrial research groups and young research minds into the field for the first time. While most of our work of necessity necessarily has to be focused on statutory objectives

of the program, it is of interest to note that some 4 months ago, or roughly 15 months after the program got under way under the new safety laws, we had a backlog of upwards of $75 million in unsolicited safety research proposals. While we obviously do not have the funds to support this level of research, the sheer magnitude of the backlog is an unmistakable indicator of a new research interest in safety.

However, as important as is the advancement of human ecology through safety research, and as important as the pursuit of valid research results is to progress, I cannot help but reflect upon this lag in getting existing knowledge or valid advances into practice.

To repeat, our automotive industrial complex must ask why the energy-absorbing steering assembly was so long in coming.

And the society must ask itself how long will it be before all drivers get the kind of training the young General Motors secretary got in safe handling of a vehicle in a hostile environment.

And the society must also ask itself other questions with regard to its willingness to permit the human ecology to receive the benefits of safety research. Witness such questions as why some communities will challenge through the courts requirements that motorcyclists wear protective headgear.

In the year following enactment of the Federal standard on motorcyclist head protection, the State of New York experienced approximately

a 40 percent decrease in motorcyclist deaths. During the same period, the State of California without such a statute, had a 9 percent increase. This is a 50 percent swing in fatality reduction associated with implementation of what already is known. While research undoubtedly must be pushed to improve upon what we already know about motorcyclist head protection, I doubt that this will produce a swing of this magnitude.

I would not want to creat any impression that we dare limit our attempts to improve human ecology solely by getting into practice what is already known. To the contrary, there are many readily identified areas of inquiry that must be pushed to achieve the 70 to 80 percent reduction in traffic fatalities that we now speculate as being within the realm of hope -- if not reason. This could readily be the subject of many other talks.

But I would want to conclude here by at least raising this question of whether the most pervasive requirement for advancing human ecology is to conduct research on how best to guarantee the implementation into practice of valid research findings as well as real lessons learned from operating experience.

How much of a lag should we, or need we, tolerate between a safety research discovery and its implementation into human ecology?

Stated otherwise, how many people have to die or be maimed by hostile environments before the society will accept proven countermeasures into the ecology.

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
NATIONAL HIGHWAY SAFETY BUREAU
WASHINGTON, D.C. 20591

RELATIONSHIP OF QUALITY AND VEHICLE SAFETY PERFORMANCE

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A year ago, at your 6th Annual Workshop, I had the privilege of discussing with you some of the plans of the Government to assure compliance by the automotive manufacturers with the relevant Federal Motor Vehicle Safety Standards under the provisions of the National Traffic and Motor Vehicle Safety Act of 1966. I also discussed other provisions of the law relating to defects notification and corrective recall campaigns.

It is a pleasure to be here this afternoon to renew old acquaintances and to reexamine some of my earlier observations. But I would like to direct most of my remarks to the most appropriate theme of this Seminar: Future Challenges to Quality and Reliability.

MAGNITUDES OF THE COMPLIANCE PROBLEM

The overwhelming challenge to industry and Government alike is in the magnitudes of every dimension of both standards compliance and defects control. We now have 28 Federal Motor Vehicle Safety Standards with varying effective dates which generate over 300 corroborative tests. When additional new and revised standards and consumer information items are issued, the number of tests will approach 1,000.

Over 500 different make/model combinations of passenger cars are introduced into the domestic market each and every year. Each is subject to over 100 test items, although the actual number of tests would be less than the cross products since manufacturers use the same parts in several different models for several successive years. However, even with appropriate adjustments for these factors, the number of combinations is still extremely large, but become astronomical when we further consider that there are:

6 bus manufacturers

47 domestic passenger car plants

53 truck plants

3,000 truck body manufacturers

10,000 tire retreaders and other elements of the auto aftermarket

30,000 parts suppliers

And so on.

The same picture of overwhelming magnitudes has unfolded in the area of defects control.

From the time the Bureau was formed, in September 1966 through October 31 of this year, it has received notification from motor vehicle manufacturers of 303 safety related recall programs involving the inspection and correction of 6,037,454 major vehicles. In addition, the Bureau has received numerous notifications of nonsafety recall programs as well as hundreds of manufacturers technical bulletins, notices, and other similar materials regarding vehicle and equipment defects.

Some other descriptive statistics on recall campaigns are illustrated here:

The total number of campaigns initiated since the start of the program rose to 290 by October 1 of this year. (Figure 1)

A total of 5,254,366 vehicles were involved. (Figure 2)

Steering, brakes, and suspension account for over 72% of the vehicles in the defect campaigns, (Figure 3) and over 72% of the recall campaigns. (Figure 4)

Another vitally important dimension of the compliance problem is the volume of complaints that the Bureau has received directly from owners. Through September the number reached almost 2,800 for the

vehicle and an additional 257 for tires. This totals in excess of 3,000 owners who judged that something was wrong with their cars, and felt compelled to write to the Government. The distribution of owner complaints is shown here. (Figure 5) Brakes, steering, and suspension account for 47% of the vehicles, in contrast to 72% reported by the manufacturer. One may speculate as to the reasons, but as shown here, substantial differences exist between the patterns of owners' complaints and the distribution of defects reported by manufacturers. (Figure 6)

CHALLENGE TO THE GOVERNMENT

These statistics then portray the magnitude of the compliance problem:

- the volume of corroborative tests with regard to new car standards,
- the volume of defects notifications,
- the volume of owner complaints.

The statistics further highlight the challenge to quality control and reliability from the standpoint of the Government.

In my talk last year I made the following statement:

> ". . . The need for a detailed systematic analysis of all facets of the compliance problem is patently obvious from the most cursory examination of sizings of the two Bureau responsibilities. Moreover, pat statements to the effect that some form of clever statistical sampling will handle the

problem are virtually idle. The problems are of far greater complexity than could ever begin to be resolved simply by statistical methods. . ."

I further pointed out that the Government's compliance program would have to evolve largely around the exception principle. That is, the largest part of the compliance dollar would have to be directed toward indications of noncompliance -- the exception to compliance as it were. Stated otherwise, corroborative testing by the Government of manufacturers' certification of compliance would have to be largely limited to suspicions of noncompliance rather than any across-the-board sampling.

Notice that even when Government corroborative testing is limited to suspicions of noncompliance, there is a substantial sampling problem within each of these situations. Equally difficult is the judgment of whether the suspicious indication is an isolated, anecdotal instance or a widespread situation.

The importance of the owner complaint file now comes into clearer focus. Each complaint is an indication of a suspicious situation, and must be analyzed, and considered for more thorough investigation. To these must be added the published reports of noncompliance in such magazines as Consumer Reports and others.

The future challenge to the Government to apply to its surveillance programs the techniques of reliability and quality control is not a single one but rather a multiplicity of challenges. The immediate challenge of the Bureau is to bring a surveillance workload of almost unbelievable proportions into reasonable bounds if it is to operate as an effective regulatory agency under the provisions of the law.

I know of no simple magical formula for meeting this challenge. I am convinced, as I stated last year, that conventional statistical methods will not work, as in some form of preplanned sampling of the entire surveillance workload. Our programs must, instead, be geared to two types of actions:

First: the identification of suspected situations of noncompliance.

Second: sufficient independent testing in the situations so identified to confirm or reject the suspicions of noncompliance.

In both of these, we have to utilize all of the tools of modern statistical inference plus a great deal of common engineering horse sense to guard against making any or all of several types of errors:

1. The error of failing to identify a major noncompliance situation.
2. The error of identifying as a significant noncompliance problem a nonexistent or trivial noncompliance situation.

3. The error of performing insufficient or otherwise inadequate corroborative testing.

Statistical methods and test procedures must be developed and applied that will minimize these errors. And this challenge is obviously magnified by the fact that very limited resources are available for these purposes.

But there is, I believe, an even greater challenge to the Government. This is to encourage industry to undertake broader scales of voluntary in-house operations in reliability and quality control. This is the obvious way of reducing the Government problem of providing the public with assurance of reasonable levels of continuous safety quality. For it is clear that as the level of industry quality control goes up, the necessity for Government surveillance of product performance will lessen.

CHALLENGE TO INDUSTRY

This leads to the next topic that I would like to discuss briefly, namely, the multifaceted challenge to industry in reliability and quality control.

A discussion on this subject can hardly start without mentioning the numbers of passenger cars involved in safety-related recall campaigns,

for no matter how you describe it, a defect recall campaign represents an incontrovertible and costly symbol of a breakdown somewhere in industry of quality control and reliability.

According to a report attributed to the New York Times, the automobile industry in 1967 produced an average of 179,000 cars a week, and recalled an average of 64,000 cars a week for inspection and correction of possible safety defects. This means that about 1 out of 3 cars were produced with a sufficient likelihood of a safety defect to warrant being included in a recall campaign. Our data suggest that this ratio might be as high as 1 out of 2.2.

But if these breakdowns in quality control cost money, so do the improvements in quality control. It is almost axiomatic that if a company chooses to spend more money on inspection, it will later spend less money on defect notifications. If it spends more money on building reliability into its product -- starting on the drawing board -- this too will cost money although I am sure you can cite instances where greater reliability was achieved at lower cost because it started early on the drawing board -- and not as an add-on late in the design cycle.

But, in general, we can surmise that even design for greater reliability will generate a cost increment.

Whether the increased reliability is bought by the company on the drawing board or later in inspection on the production line, I think

that it still will be substantially less than the burden of defect recall costs.

Whatever the correct ratio, it still is an almost unbelievable state of affairs, and if I may quote from a Consumer Report article:

> "...there's little comfort in the thought of an industry that needs to recall almost one-third of its output..."

I hardly need reiterate here the seriousness of such statements.

I hardly need attach a dollar figure to this situation. But if the unit cost to the manufacturer for defect notification is $10, the 6,000,000 vehicles recalled so far represent a $60 million price tag for the breakdowns in quality control; if the unit cost is $100, then the price is $600 million. Each company obviously can do its own arithmetic on this; but the answer will be unpleasant from any standpoint.

And I haven't mentioned the additional safety that this additional reliability and quality control will buy apart from saving the company money.

Obviously, I cannot quantify the dollar cost burden to purchase additional reliability and quality control with any substantial confidence as to the accuracy of my results. Nor can I do a better job in estimating the lives that the additional reliability will save.

But there is a decision framework that is emerging, and I would like to explore it with you. Figure 7 illustrates three conditions, each deals with these fundamental characteristics:

1. The minimum level of acceptable safety performance.

From the standpoint of the Government, this would be a Federal Standard; from the standpoint of industry it might well be the threshold of consumer acceptance or influence upon sales.

2. The mean or central tendency of the statistical distribution of quality of the output.

Within the decision framework, this might well be the nominal design value.

3. The variance of the statistical distribution of output quality.

This essentially represents the spread in quality achieved in actual production. It can reflect the usual compounding of production tolerances of mating parts. It can also reflect the proverbial unprogramed situation of some worker failing to adjust a torque wrench as called for in a production drawing.

Or it can reflect the reality of life that no one is going to correct -- namely, that production tooling wears progressively and not in some "all or nothing" mode in which

> perfect parts are produced continuously up to a point and then in some absolute fashion all parts become bad.
>
> I need not discuss the many different varieties of production gremlins that keep you awake nights. But they all do add up to this very important property of variability in output production.

Referring to the chart, Condition A reflects a situation where the expected value or nominal design is fairly close to the threshold of acceptability, but still within the acceptable range. The variance of the output distribution is, however, fairly large.

The nearness of the nominal design level to the standard and the size of the output variance combine to produce a situation in which a substantial portion of the distribution fails to meet the standard. This is the crosshatched portion below the standard value.

Condition B is the same as A with the exception that the output variance has been substantially reduced so that a comparatively small part of the tail of the statistical distribution falls below the standard.

Condition C illustrates a high output variance again but with a much higher nominal design. The result is that in contrast with the other high output variance situation in A a comparatively small part of the output is below standard.

This is, of course, a gross simplification but it does serve to illustrate qualtitatively what I believe to be several important elements of industry's decision framework for reliability and quality control.

Condition A is going to produce the high cost burden of large defect recall campaigns.

Condition B in contrast to A will cost more in inspection and quality control dollars, but will produce a lower cost burden in defect recalls.

Condition C will, as in B, produce lower cost burdens in defect recalls. But this is achieved by "overdesign" to compensate for production gremlins.

Of course, many variations of this simplified representation may be recognized. For example, the cost burden of the excessive recalls implicit in Condition A can be reduced by tighter process controls that enable the manufacturer to place more narrow bounds upon the part of the production run where a safety defect is known to have occurred, and thereby reduce the number of vehicles that we recalled. I believe that I discussed this concept with you last year in the question and answer period.

The representations can be further complicated by including the two additional factors of: (1) cost to the manufacturer to correct a defect, and (2) the degree of hazard in an uncorrected defect. No one

should permit a Condition A to develop for an aspect of the vehicle of major safety implications - such as steering or brakes. On the other hand, industrial decision-making moving toward Condition A is less undesirable for vehicle aspects of lesser safety importance.

Obviously, from the safety standpoint, I would strongly advocate that industry strive for the ultimate, which I haven't even illustrated, namely, the highest possible nominal design value coupled with the lowest possible output variance. But while this might be the ultimate, the realities of product cost and safety tradeoffs also must be recognized. High nominal design values and low output variance for the critical safety properties might be possible only by accepting lower nominal design values and higher output variance for less critical safety properties. This is a very difficult type of decision for industry and Government alike. There are no hard and fast rules to apply; every situation will pose different problems, and each will have to be examined on its merits. Clearly, "the rule of the reasonable man" must apply.

The Government's surveillance problem has another difficult aspect which also interacts with the decision framework of industry. As I mentioned earlier, one of the most important aspects of the Government's surveillance program centers on the compliant letters received from the consumer. Each must be thoroughly analyzed, with every indication of a non-compliance situation requiring a decision on whether

or not to follow up with corroborative testing. This is to decide if the single instance called to our attention is a remote, isolated occurrence or part of a widespread situation to which we should allocate some of our scarce corroborative testing dollars.

What additional information will we have? Hopefully, we will have generated enough experience to decide whether the reported instance arises out of a Condition A, Condition B, or Condition C situation. It almost goes without saying that if we have any evidence that Condition A prevails, we wouldn't hesitate to proceed with corroborative testing, we would be less likely were it a Condition C. Common horse sense would dictate this course of action.

An additional dimension of the industry decision framework is illustrated in Figure 8. The major parameters are the same as in the previous slide, namely: a standard of acceptable performance, an expected value or central tendency, and an output variance. The additional dimension of time has been added.

The fundamental question that I would raise relates to the manner in which the values of these parameters change over time. The issue is not whether or not the mean value of the statistical distribution of vehicle performance changes over time, but rather how the change takes place. This issue was discussed at great length in our recently

released report to the Congress on used vehicle safety.* To quote from this report:

> ". . . Conclusion. The safety performance of a vehicle in use cannot be isolated from its original design and construction. It is axiomatic that used vehicle safety can and must start on the new vehicle drawing board.
>
> a. The level of safety performance designed into the vehicle in accordance with 'new vehicle' performance standards is the beginning point for defining maximum permissible safety performance deterioration in a used motor vehicle safety standard.
>
> b. Reliability of extended performance is universally recognized as one of the critical elements in automotive design. A vehicle purchaser should be able to have some assurance that critical areas of safety performance will not fail during a specific period of use.
>
> c. Vehicles can be designed so that repair is facilitated by easy identification and replacement of worn parts. In addition, the vehicle can be designed to coordinate with automated diagnostic equipment to facilitate analysis of the inoperative or worn parts or systems to determine the repairs required.
>
> Plan. The Department of Transportation will investigate the feasibility of broadening the scope of new vehicle standards to cover safety performance after periods of extended use, together with procedures to facilitate the diagnosis and correction of worn systems and parts . . . ."

Referring again to Figure 8, the challenge to industry rests in the decision framework on the trade-offs between various types of cost burdens, leaving out of the discussion the issue of safety and the overall public interest. We know that some important safety deficiences may

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* "Safety of Vehicles in Use", Report to the United States Congress from the Secretary of Transportation, June 1968.

come to light substantial periods of time after original manufacture. The law is clear as to the responsibility of the manufacturer for such defect notifications. Specifically, the requirement to notify the original purchaser or the subsequent purchaser to whom the warranty has been transferred continues regardless of the time that has elapsed from the date of purchase. In this sense, the portion of the distribution below the level of acceptability represents a cost burden to the manufacturer to whatever extent it is comprised of vehicles with original owners.

There also are some important issues that relate to the second or subsequent owners of a vehicle that would have been included in a defect recall campaign had there not been a transfer of ownership. The possibility of a product liability suit is always present. I wouldn't want to speculate on either the likelihood or the course of such litigation; I would defer to legal experts. The situation boils down to the fact that the manufacturer would have admitted with his defect notification to the original purchaser that a vehicle with a safety-related defect had been produced. Suppose the defect, uncorrected by the manufacturer because at the time of its discovery there had been a transfer of ownership and hence there was no legal requirement to notify the new owner under the safety law, contributed to if not directly caused an accident, what would the legal defense be in a product liability suit under common law?

Let us make the example even more specific. Suppose the new owner, prior to the accident, had, in fact, requested the manufacturer to correct the defect in the same manner that the manufacturer had corrected similar defects in vehicles still owned by the original purchaser?

The point I make here is clear. There are substantial reasons for industry to provide for reliability and quality control for extended periods of time beyond the date of original sale.

Industry has, of course, always been concerned with providing products that will perform reliably over extended periods. They have always been cognizant of the interest of the original purchaser in the potential resale value in his intended purchase. In fact, substantial portions of the new car advertising budgets are directed toward this theme of probable resale value. Reliability has been an important design objective for years.

But the challenge to manufacture products of higher safety reliability is now greater than ever before. Failure to produce products that perform reliably can produce defect recall cost burdens to the manufacturers far greater than the costs of providing additional reliability dollars on the design drawing board or production line.

I have portrayed industry's cost model as a form of competition between paying the price of defects versus the price of increased

reliability. This is, I believe, a realistic representation of industry's decision frame of reference.

But my personal belief is that the payoff in increased reliability will far exceed the costs of achieving the increase, that payoff will come not only in lives saved but in the overall company balance sheets. While the investment in increased reliability will produce higher operating budgets of reliability departments, there will be elsewhere in the company substantially greater "virtual" cost reductions in dollars paid out. I say "virtual" cost reductions because they are dollars that were not paid out; they are the costs that would have been incurred had there been defect recalls. Needless to say, as with attempting to count the accidents that did not happen, these virtual cost reductions are extremely difficult to estimate, let alone convince top management of the validity of the estimates.

I further believe that improved reliability will produce another positive mark on the company balance sheet. This is in the all-important column of increased sales. As information to the consumer increases on product safety and safety reliability, the marketplace will begin to provide an even greater stimulus to increased company investments in reliability.

Conceivably, the day might come when an informed marketplace might lessen if not obviate entirely the need for any Federal

rule-making actions. The implications in this statement are, I believe, abundantly clear.

CONCLUSION

Today I have engaged in the luxury of wholly heuristic argument in support of my viewpoint - an optimistic one which, if proven to be correct and implemented by industry, will find the public, industry, and the Government all profiting.

The challenge to you, the leaders of automotive reliability and quality control programs, is to reduce my heuristic beliefs to proven formulations that your top management can accept.

Product safety and reliability need not resort to evangelism; solid business-like facts and an informed marketplace as to these facts will do a much better job than pious pronouncements.

This is your challenge, and with it go the most fervent hopes of your Government and your 200 million fellow Americans whose lives and pocketbooks are at stake, that you will successfully meet it.

MOTOR VEHICLE DEFECTS REVIEW

SAFETY RELATED RECALL CAMPAIGNS BY MONTH - CUMULATIVE

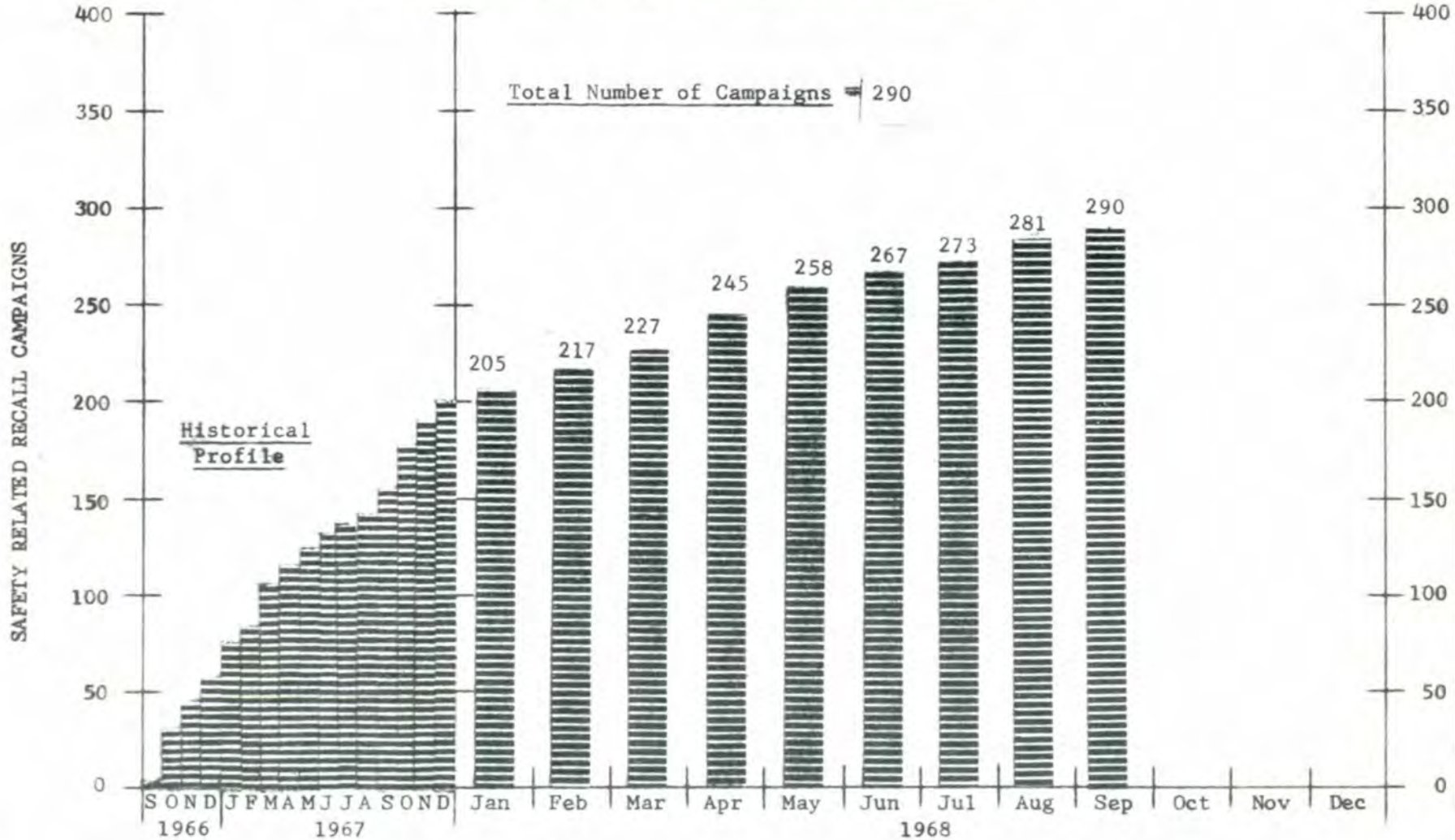


FIGURE 1

MOTOR VEHICLE DEFECTS REVIEW

VEHICLES RECALLED (SAFETY RELATED) BY MANUFACTURERS BY MONTH-CUMULATIVE

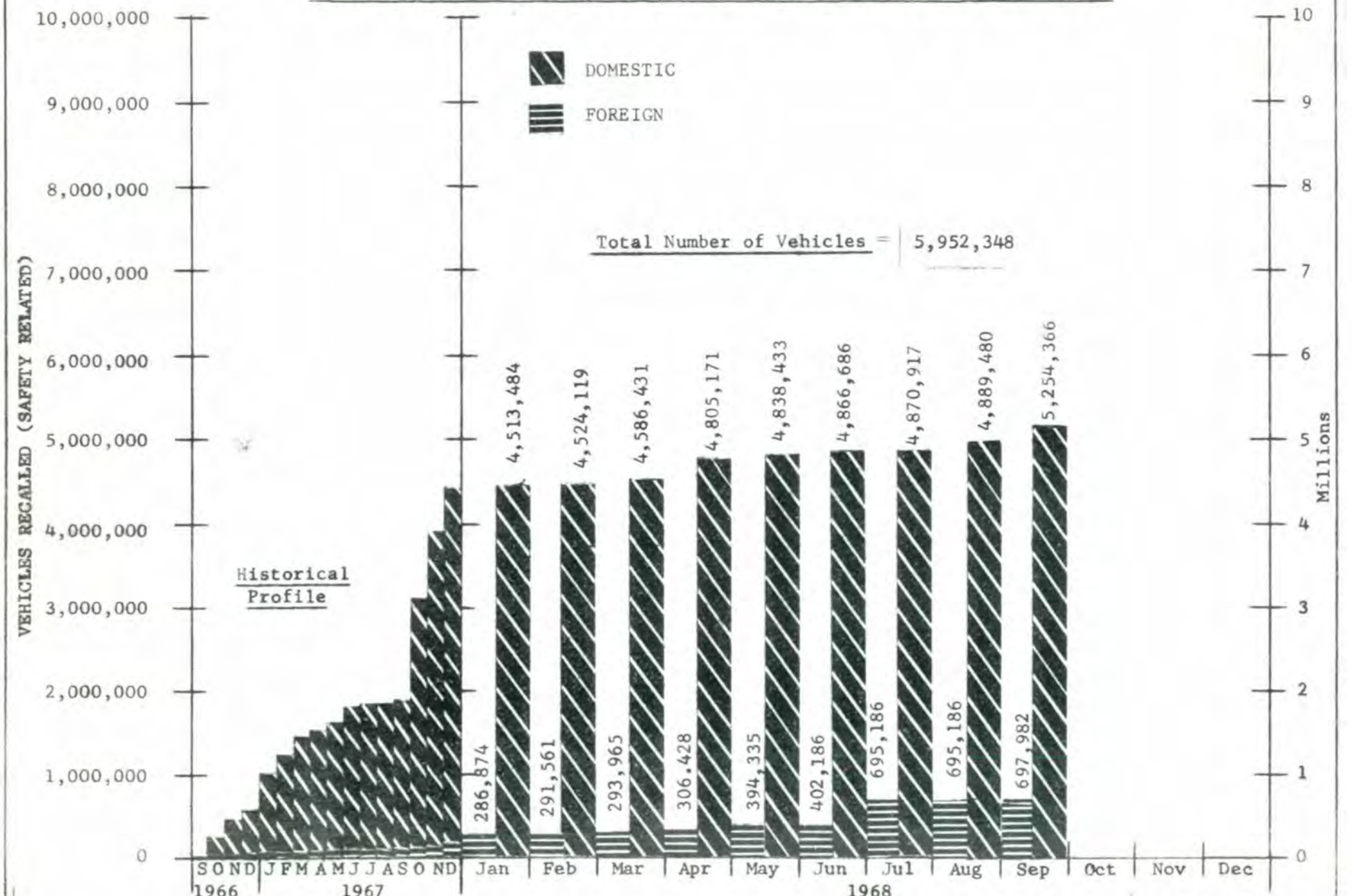
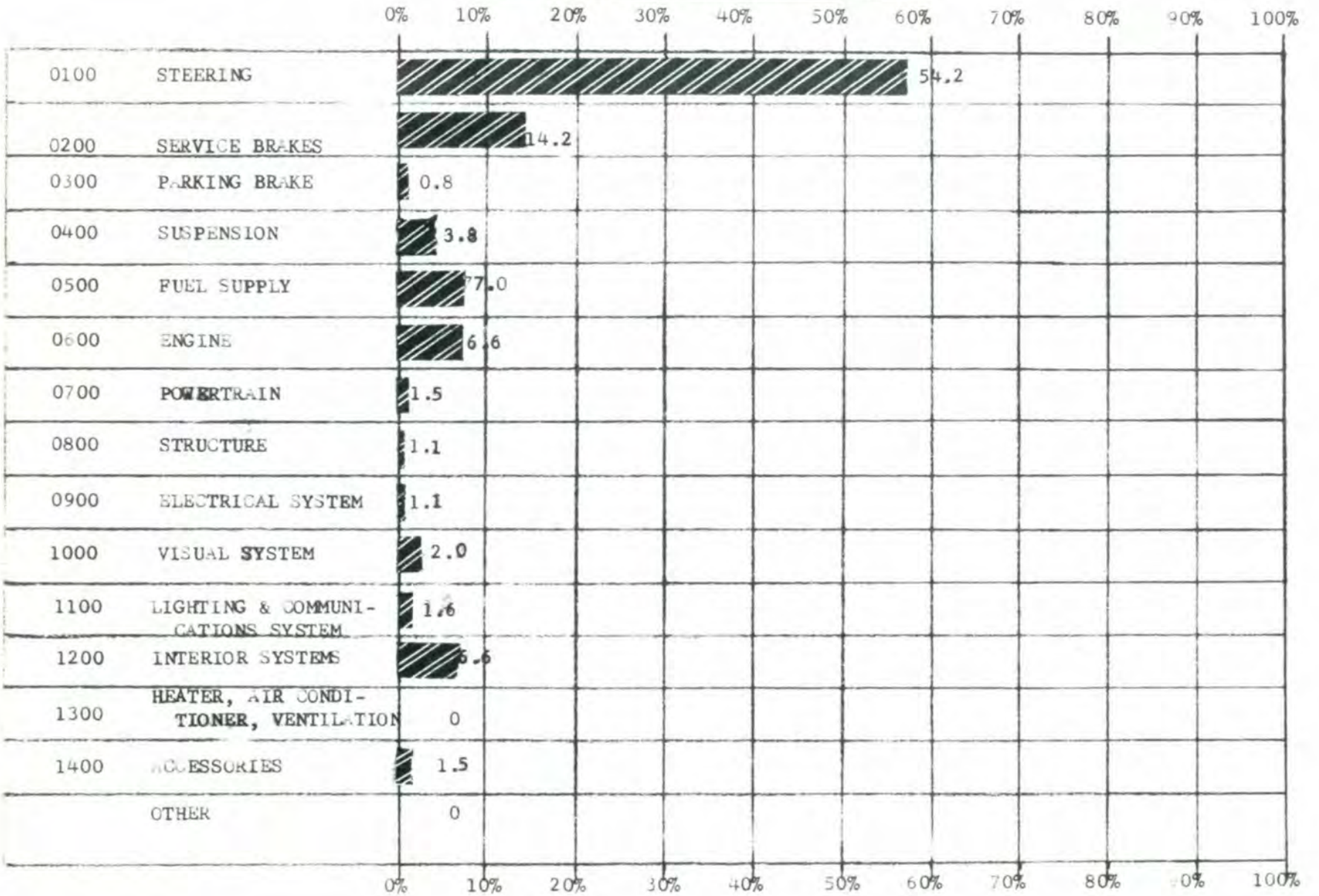


FIGURE 7

PERCENTAGE OF ALL MOTOR VEHICLES RECALLED FOR POSSIBLE SAFETY-RELATED DEFECTS THAT INVOLVED SPECIFIC VEHICLE SYSTEMS

September 9, 1966, to September 30, 1968



FIGUR 3

PERCENTAGES OF SAFETY-RELATED RECALL CAMPAIGNS
THAT INVOLVED SPECIFIC VEHICLE SYSTEMS

September 9, 1966, to September 30, 1968

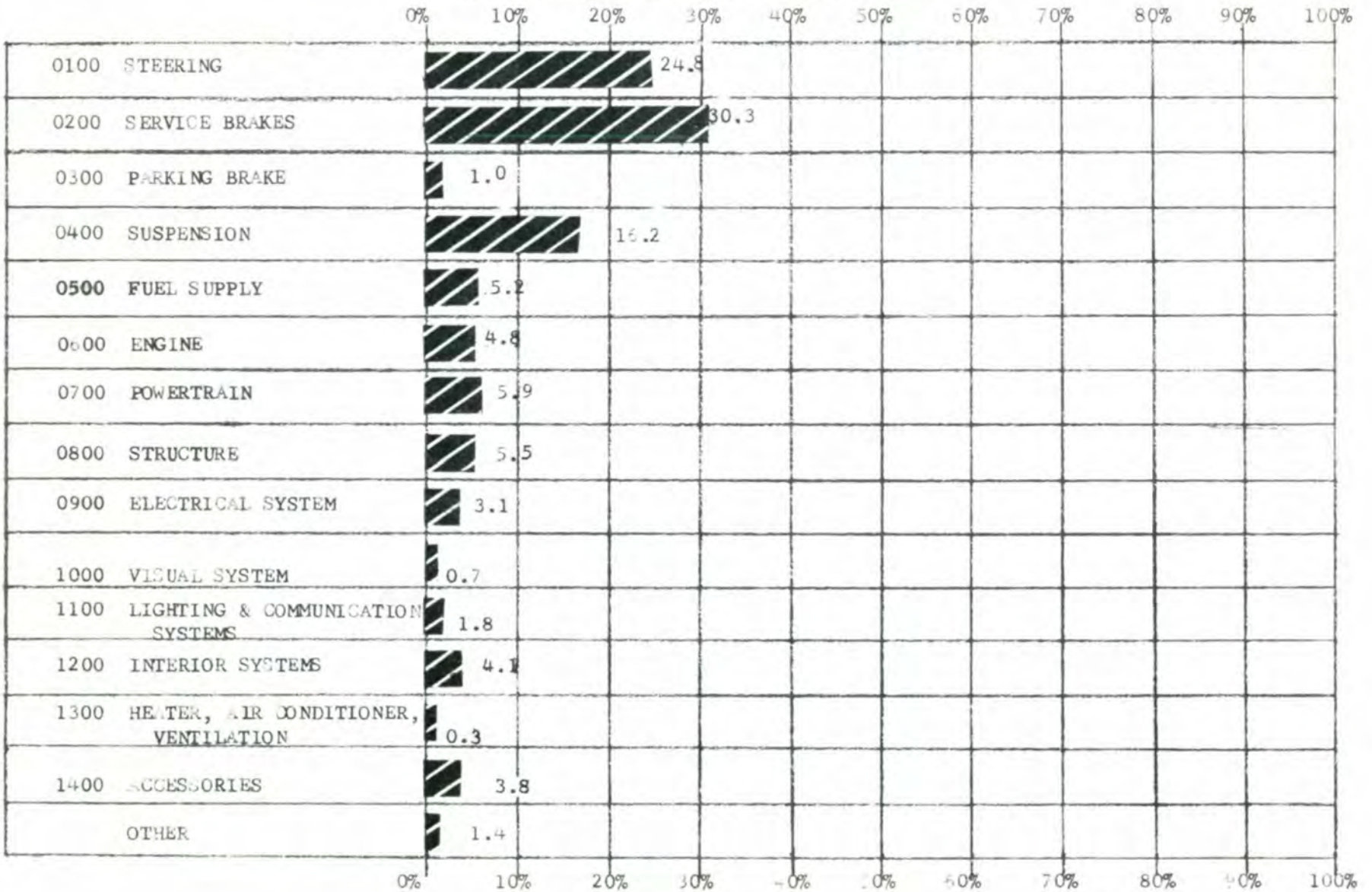
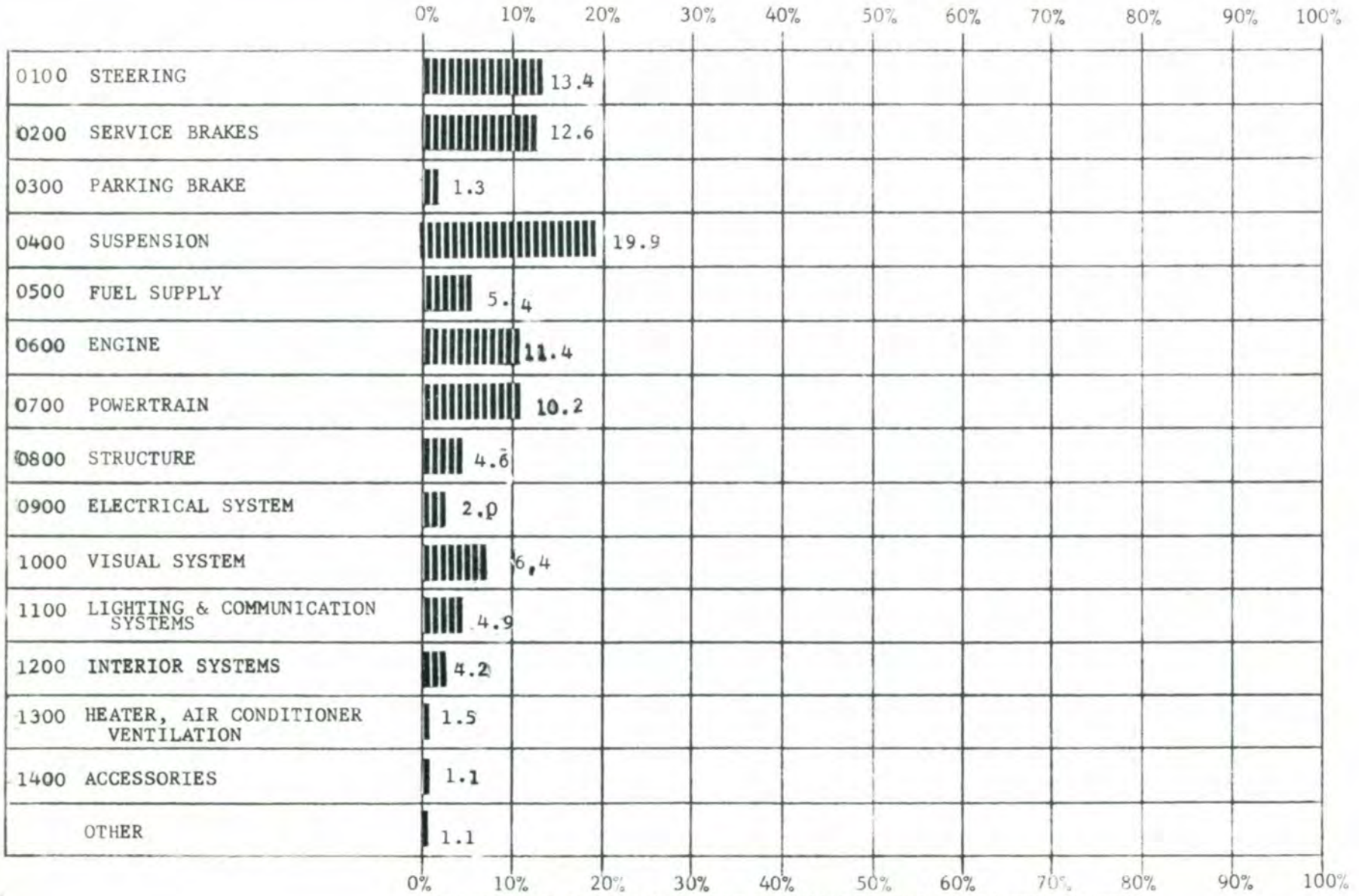


FIGURE 4

MOTOR VEHICLE DEFECTS REVIEW

CLASSIFICATION OF OWNER COMPLAINTS - September 9, 1966 September 30, 1968



FIGU 5

NATIONAL HIGHWAY SAFETY BUREAU

DISTRIBUTION OF DIFFERENCES BETWEEN OWNER COMPLAINTS
AND MANUFACTURER'S REPORTS OF DEFECTS
(SEPTEMBER 9, 1966 - SEPTEMBER 30, 1968)

	MANUFACTURER*	OWNER**
STEERING	54.2	13.4
SERVICE BRAKES	14.2	12.6
PARKING BRAKES	0.8	1.3
SUSPENSION	3.8	19.9
OTHERS	29.0	52.8
	102.0	100.0

* BASED ON 5,952,348 VEHICLES

** BASED ON 2,784 OWNER COMPLAINT LETTERS

NATIONAL HIGHWAY SAFETY BUREAU

SAFETY PERFORMANCE

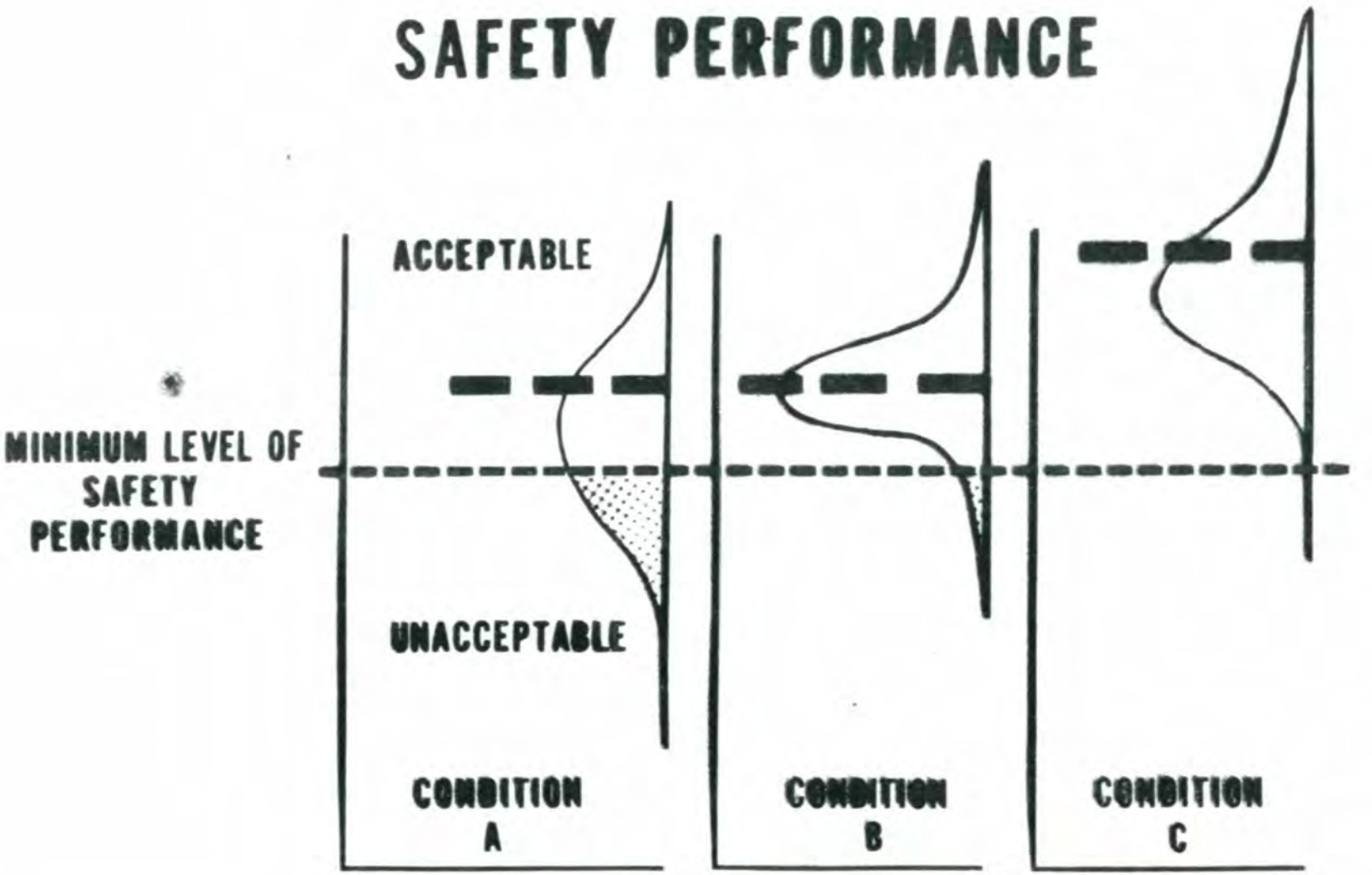
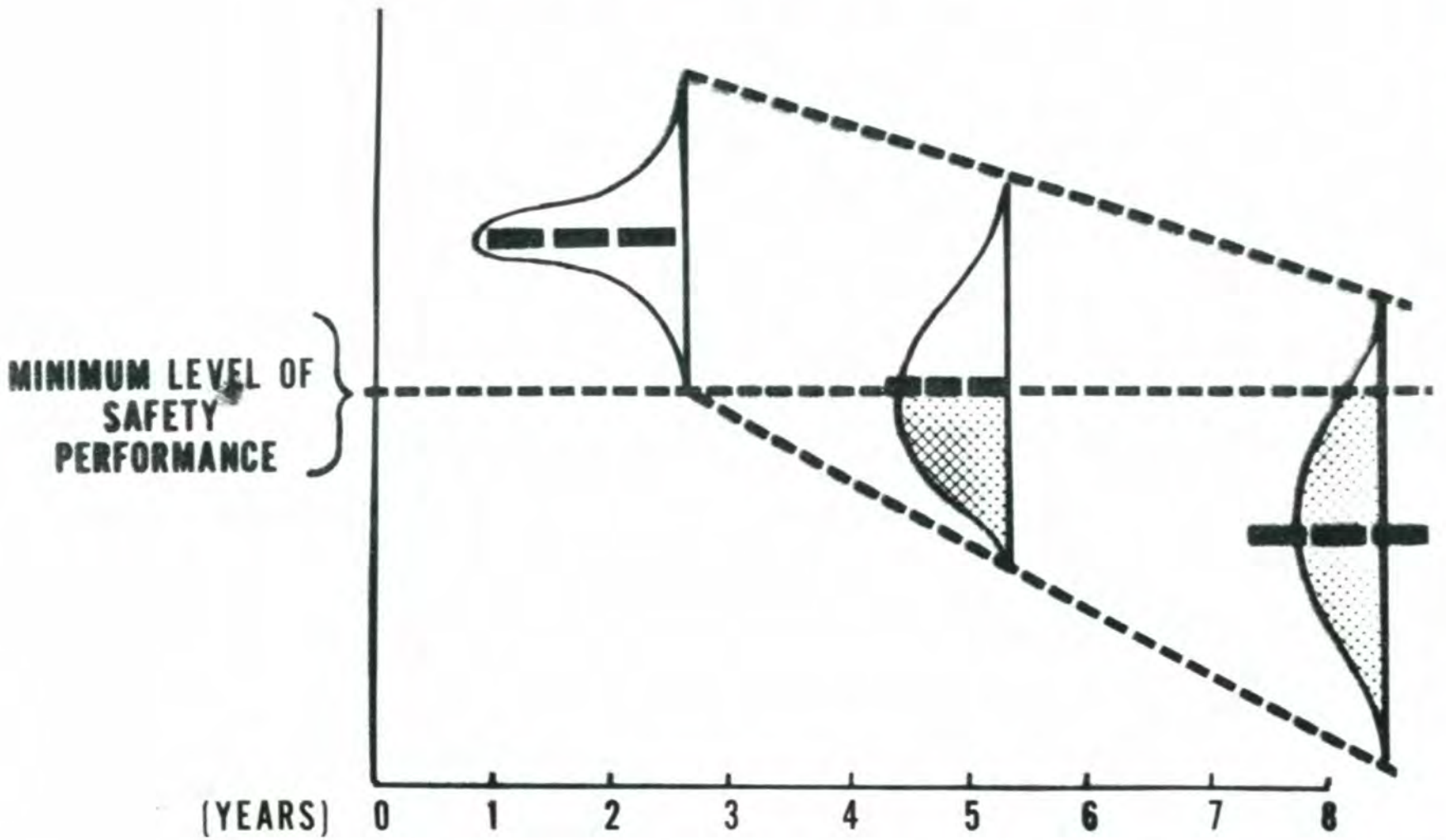


FIGURE 7

NATIONAL HIGHWAY SAFETY BUREAU



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INCONCLUSIVE PROOFS OF PAYOFF IN DRIVER EDUCATION AND OTHER CRASH PREVENTION MEASURES

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Before the
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Institute for Educational Development
Oakbrook, Illinois
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INTRODUCTION

The Highway Safety Act of 1966 requires each State to have a highway safety program designed ". . . to reduce traffic accidents and deaths, injuries, and property damage resulting therefrom . . . ." It is for this reason that the National Highway Safety Bureau was established. Its mandate is to assist the States to achieve the goal of fewer traffic deaths and injuries.

The Act further provides that to be approved by the Secretary of Transportation, a State highway safety program must include comprehensive driver training: it is the only substantive action program so specifically identified. Clearly, the Highway Safety Act envisions driver education and training as a most important countermeasure to the rising toll of highway crashes.

However, modification of driver performance is but one of several ways of approaching the problem of reducing highway crashes. And, driver education is but one of several ways of attempting to alter or control driver performance. The mandate of the Bureau is not to promote driver education per se, but to promote safety through driver education and any other measures that will produce the ultimate goal of lives saved and injuries prevented.

Driver education must, therefore, compete with other traffic accident countermeasure programs for limited financial resources. There can be and are no sacred cows in highway safety. Resources cannot be allocated to activities that aren't paying off, for there simply aren't enough funds for those that are producing results, or have this promise. All activities must, sooner or later, pass the test of effectiveness. And this test must be in the context of highway safety primarily, with corollary social benefits being of secondary importance from the standpoint of safety resource allocations.

The mission of the National Highway Safety Bureau is highway safety, not education as such. Accordingly, it is the efficacy of driver education as a highway death and injury countermeasure, not its role in producing better citizens in the broad meaning of this term, that will largely determine how much of the safety dollar it will and should receive.

In a most pragmatic vein, we must buy the greatest savings in lives with the dollars earmarked for this specific social goal. And we must do so wherever and however we can -- whether by preventing the occurrence of crashes or by increasing the survivability of the crashes that do occur.

Driver education is a crash prevention activity; the use of seat belts, on the other hand, is a crash survivability measure. The payoff of seat belts, occupant restraints, other vehicle design improvements that increase crash survivability has been established beyond a shadow of doubt. The payoff of driver education is under challenge.

But it is not the only crash prevention activity whose payoff is under challenge. For example, motor vehicle inspection is also in question as is the role of the traffic courts in the ultimate analysis of lives saved as a result of these and other programs that traditionally have been part of highway safety.

Evidence of substantial payoff in <u>any</u> crash prevention activity is extremely difficult to obtain. Unfortunately, the failure to obtain such evidence, which I believe is intrinsic in the nature accident causation statistics, can readily lead to such absurd misinterpretations as ". . . there is no point in inspecting brakes to assure proper working order because no one has ever established statistically significant correlation between bad brakes and accidents . . . ."

Driver education is necessary, and we no more need address the question "Do we need driver education?" than the question "Do cars need brakes?".

But there are many questions yet to be answered on how best to teach the driving task to teenagers in public schools or to adults in professional driver training schools.

Similarly, there are as yet many unanswered questions on brakes: drum vs. disc, diagonal vs. conventional, 2-wheel or 4-wheel anti-locking systems. Even more difficult, braking issues have not been resolved on the used motor vehicle. Brakes must deteriorate with time and use, and abuse. How much deterioration should be permitted before the society, through the appropriate motor vehicle inspection standard, mandates that corrective repairs must be completed before the vehicle is permitted to operate again on public thoroughfares.

And since good driver performance and good vehicle brakes are only two of many traffic accident countermeasures, how much should the society invest in them in comparison with the investments in other countermeasures? If $10 or more is spent each year on training each of 10 million new drivers, somebody is picking up a $100 million tab. If motor vehicle inspection generates $10 extra in brake work each year for each vehicle in use on public thoroughfares, the total for the 100 million vehicles in use is $1 billion.

This kind of arithmetic is easy to perform, once the dollar values of the unit measures are established. It is much harder, of course, to determine what these dollar values should be. But the most difficult task by far is to establish the return produced by these unit expenditures and their aggregate in the context of setting national investment policy.

In this hyper-simplified exercise, I state that ". . . somebody must pick up the tab of highway safety . . . ." I make the statement to emphasize what possibly has been overlooked, or at least has received very little mention in the context of the new Federal emphasis on the problem. This is the vast multiplier effects that the comparatively modest authorizations for Federal funding under the two long overdue safety laws have upon other sectors of the society; on public agencies, industry, and the all-important individual citizen -- both from the standpoint of his pocketbook and his chances to live on highways and to let others live to see the safe arrival of their destination.

Let me use the case of tire wear to illustrate this multiplier principle. The Department last year issued a tire safety standard that requires, among its several provisions, that when the tire has worn to where its depth of tread is 1/16", a different collor band will appear to serve as a readily recognized indication of the need for replacing or retreading the tire. If the value had been set at 1/8", the additional average operating cost might have increased by $10 per

car per year, with various assumptions as to mileage associated with tread wear, cost of tires, annual miles driven.

The maximum level of tire wear called out by any Federal, State, or local regulation translates into operations costs to the motorist as inexorably as poor gas mileage due to fouled sparkplugs or a badly tuned engine.

And similarly, a Federal standard that calls for doubling the hours of behind-the-wheel instruction accordingly changes the investment in driver education -- whoever pays the bill.

Thus, every rulemaking action, whether directed toward the vehicle, or the highway, or the driver, must be examined in the context of the level of investment that will be required to implement it. For clearly, it is virtually idle to issue a rule or standard which generates costs that cannot be met with available Federal, State, local or private sector funds.

With the enactment of the two vehicle and highway safety laws in September 1966, sustained and significant Federal support became available for the first time. As I stated earlier, this was long overdue.

But the available funds are far below needs in every aspect of the all-out effort and multifaceted provisions of the two laws. Consider only the Highway Safety Act with its provision for strong driver education programs being of most immediate relevance to this symposium.

Roughly, about $60 million of Federal support is available in this fiscal year for grants to States in all highway safety programs including driver education. The States have estimated their needs at approximately $600 million. This means that $1 is available for about every $10 of need.

The States further estimate that by 1976, the deficiency will be in excess of $2.5 billion annually. Although we anticipate, and the Congress has given every indication of increased support, it is nonetheless clear that available funds will always be far below needs.

This adds up to one word -- priorities. Priorities in resource allocations among the various activities that comprise a highway safety program.

We all have recognized the need to assign priorities, but most important, this is also the specific directive of the Congress. Specifically, the Conference Committee on Appropriations of the Second Session, 90th Congress, included the following directive in its Report No. 1833 on appropriations of Department of Transportation funds for fiscal year 1969:

> "The committee of conference directs that the funds provided be obligated only on the lost essential and practical program activities in the belief that concentration of funding on fewer programs than are proposed in the budget will result in more clearly demonstrable accomplishments."

A directive of this nature is unmistakably clear. In effect, it calls for learning how the entire field of improving driver performance,

by whatever means, shapes up as a family of countermeasures, when compared to improvements in vehicle and highway design, for example; how driver education shapes up when compared to other ways of improving driver performance. It forces answers now on how much attention is to be given to the driver, to the vehicle, and to the roadway; on how the resources are to be allocated among the several highway safety program elements.

In accordance with this directive, we developed a schedule of priorities for providing Federal grant-in-aid support to States for highway safety activities. The priorities are designed to place balanced emphasis between program areas anticipated to produce relatively near-term payoff and those of a longer range nature which, however, call for the development and operation of needed basic data and information generation systems. High priorities are assigned to the immediate payoff or foundation building program areas, low priorities are assigned to the others.

Scientific evidence, not tradition, should direct the pattern of these priority assignments as directed by the Congress for the public investment in highway safety -- particularly in light of the vast multiplier effects produced thereby.

Unfortunately, the highway safety field which is replete with tradition is concomitantly lacking in scientific evidence of payoff.

We accordingly chose to assign high priorities to those program elements that had promise of demonstrable near-terms payoffs or at least would lay the groundwork or foundation for obtaining such evidence in the near future. We assigned low priority to those program elements that had tradition going for them but little more in the way of conclusive evidence or promise of producing conclusive evidence of payoff.

Driver education was assigned to the low priority group. There were two basic reasons:

1. Evidence of payoff is as yet inconclusive for driver education programs.
2. Operational programs as conducted by States and local units do not generally provide for rigorous self-evaluations one year, two years, or twenty years hence.

The effect of these priority assignments is <u>not</u> to cut off driver education support. In fact, in terms of absolute dollar amounts, we anticipate that more support will be available than ever before because the overall highway safety appropriations are increasing.

What has been done is to impose a ceiling on the percentage of the Federal safety dollar that can be used by States on driver education.

Furthermore, it must also be borne in mind that this restriction pertains to the level of investment in operational driver education programs -- production of trained drivers as it were. It does not pertain to research in driver education. Moreover, we feel that the need for greatly expanded research in driver education has never been greater. This position is exemplified by the sponsorship by the Department of Transportation of this symposium, and by our call for extensive longitudinal research in driver education, in the belief that conclusive evidence will not be obtained in some magical overnight breakthrough.

In effect, the very pragmatic position of the Government is to keep the level of the Federal support in operational driver education programs under reasonable control while going all-out with research to obtain better scientific evidence than heretofore has been available on the overall payoff in driver education or the differential payoff among alternative driver education techniques.

Let us not kid ourselves, conclusive scientific evidence is not widely prevalent on either of these types of questions. We have repeatedly asked experts to advise on what the allocation of resources should be between behind-the-wheel and classroom instruction. We have received opinions and, of course, have taken them into account as the best subjective judgments of our experts. But even the experts do not agree among themselves, and none offers conclusive scientific evidence in support of his position.

We can complicate matters further. Instead of limiting the inquiry to the simple issue of behind-the-wheel versus classroom dollar investments, consider some of the startling new developments that have begun to revolutionize the art of modern teaching -- television, electronic teaching laboratories, self-instructional devices, instructional packages of various types, computers, data and data transmission systems, new library technologies.

What are the criteria for allocating resources among these devices? Should we put money into them in contrast to providing better training to the teachers? Possibly the better investment is to upgrade behind-the-wheel training to include training students in the handling of vehicles in skids and other situations of impending loss of control.

And there is the additional intriguing idea that possibly we should begin to place more emphasis on affecting driver performance by new approaches to driver licensing -- using this as an instructional rather than a selection mechanism.

Until the data are available to back up the answers to questions such as these, driver education and other highway safety efforts will continue to struggle for support.

Driver education cannot be described as an activity that has failed to produce payoff in fewer deaths and injuries. If there has been a failure, it is in there not having been mounted as yet a research effort capable of yielding conclusive answers -- yea or nay -- on the overall effectiveness of driver education, or on the comparative effectiveness of alternative driver education techniques.

This field has suffered the blight of the inconclusive experiment -- the one that is planned, carried out, data interpreted, and then reported in the literature although some reflection at the start would have indicated that the work as planned couldn't possibly be capable of producing demonstrable differences. And the repeated failures to produce such demonstrations are, in turn, interpreted as failures of the program to produce results. The scientist properly reports that the data obtained did not permit him to reject some null hypothesis on the effectiveness of driver education; the layman, and sometimes even fellow scientists, immediately reach the unwarranted conclusions that driver education is ineffective.

Possibly the driver education programs under test were in fact ineffective. On the other hand, they possibly might have been effective but the inconclusive investigation was incapable of detecting this effectiveness. The reasons for this possible lack of sensitivity of the investigation to the phenomena under study could lay in any of the

multiplicity of factors that are well-known contributors to error variance in any kind of educational research. And the problem is compounded further when the criteria of effectiveness are poisson-distributed accident data.

For years, the highway safety field has limped along with almost trivial research support. Many of us in this field have, both in public and private, in print and on the podium, decried the fact that the field was replete with the self-fulfilling pronouncements of its experts. In fact, my earlier statement in this talk is very much in this vein; repeating it here:

> ". . . unfortunately, the highway safety field which is replete with tradition is concomitantly lacking in scientific evidence of payoff . . . ."

And there have been many other statements to this same effect "armchair philosophy", "conventional wisdom", "absence of scientific rigor" and so on.

It would be one of the supreme ironies of the day if the pursuit of scientific evidence of highway safety program effectiveness led to the dismemberment of organized highway safety programs. Figuratively speaking, to throw the baby out with the bath.

Let me point out that this would not be the first time that inconclusive or inadequate scientific evidence, properly interpreted by the responsible scientist but falsely produced more harm than good.

But if good research that fails to produce conclusive results in support of driver education is a problem, then atrocious research that purports to support driver education is a far nastier problem. Let me make my position clear, therefore, that we should and must continue to seek better scientific evidence of program payoffs, that armchair wisdom won't go far in the assignment of priorities and resources to driver education.

However, we cannot overlook the danger inherent in the misinterpretations of the scientifically sound yet inconclusive investigations of driver education.

Instead, we must recognize with complete candor that in driver education research we are, figuratively speaking, swimming upstream -- possibly for more than in other areas of research on how to affect human behavior. Enormous sample sizes are needed to test effectively even almost self-evident hypotheses when the criteria center on accident involvement. Matters don't improve very much with the substitution of so-called proxy measures such as moving violation historics of the test subjects.

In one investigation that I recall, statistically significant correlations between static visual acuity and accident involvement did not begin to appear until the sample was in excess of 15,000 drivers selected randomly from the general population.

I hardly need take the time here to recite the many factors that are contributing to error variance in driver education research:

- the statistical rarity of the accident event, necessitating long periods of observations awaiting sufficient numbers of criterion events to occur
- the probably erroneous assumption of stationarily of the relevant distribution during the course of this waiting period
- personal differences among test subjects
- the almost impossible task of rigorous estimation of exposure to risk

And so on.

These are only some of the reasons why I call for caution and realistic appraisals of what can or should be promised in the way of outputs -- at least short-term outputs of driver education research.

Inconclusive results are the expected; conclusive results the unexpected.

But the dangers of misinterpretations of the inconclusive findings cannot be, in my mind, overemphasized.

And this danger is not limited to driver education, driver licensing and other activities aimed at influencing driver performance. Consider some of the safety issues in vehicle braking performance and tire wear. To the best of my knowledge, no one as yet has produced statistically significant correlations between bad brakes and accident likelihood.

To cite another example, an author in a recent publication reported no correlation between the condition of the tires and accident involvement.

Visual acuity, driver education, braking performance, tire wear; all with low or no statistically significant correlations with accident involvement. Based upon such data one would hardly proceed to drive on a freeway with a vehicle whose brakes had totally failed, or to drive on a rough mountain road in a vehicle whose tires were worn bald. Nor would one advocate permitting a blind person to drive, or a youngster who had never been behind the wheel of a vehicle to venture without any training whatsoever onto a freeway alone.

All of these are absurd possibilities stemming from the extension to the limit of conclusive statistical findings of "no evidence of effect".

Absurdities in the limit, yes. But I do not know when the operational decision stemming from the accident research that yield the low correlations changes from scientific to absurd, if not to the scientist then at least to the lay public.

Inconclusive results in safety research are the expected; conclusive results or proof of program effectiveness is the unexpected or the rare event. We all share the wish that this weren't so.

But it is so, and will continue to be so until the nation makes the decision to attack the problem on a research scale commensurate with its complexity.

In the meantime, I am afraid, that many will continue to have a field day with the inconclusive results -- quoting them piously, or attacking them with spirit -- as the occasion warrants. And not necessarily in a consistent manner, unless the consistency is limited to self-interest, enlightened or otherwise.

As I stated earlier, if for no reason than our resources don't permit it, there can be no sacred cows in highway safety. No silver bullets, magical nostrums, or panaceas.

I do not know, for example, but that we should begin to reexamine even organizational sacred cows that carefully compartment driver education from driver licensing, from the traffic courts system that has to deal with the failures of the first two.

I believe in driver education. But at this point in time I believe at least as much in driver education research, for driver education is in competition in the fullest sense of the word for the very limited safety dollar.

Payoff evidence, not emotional appeals or heuristic arm waving will be required for it to hold a place in the all-important allocation of resources among competing countermeasure alternatives for reducing traffic deaths and injuries. And I am not so sure that it will win with emotional arm waving. Even if I restrict my alternatives to the safety investment by the typical school district, I must ask for the criteria

for investing in the upgrading of driver education in contrast to say investing in improved maintenance of school bus brakes.

It would be interesting to poll this audience on this simple question -- more money on school bus maintenance or more money on driver education -- but not both because the money for both simply is not there.

It would also have been interesting to have polled the citizens around Huntsville, Alabama, on this same question last April when a school bus there lost its brakes, went out of control, and four or five children were killed -- others seriously injured.

It might even be more interesting to poll those same people near Huntsville on the same question today. For another school bus there lost its brakes about 2 weeks ago -- and more children were killed.

No, I am not sure that driver education will do well on emotion alone.

These are brutually tough investment questions, that have to be attacked with all of the research skills we can command. They are not going to go away by themselves.

And if the advocates or opponents of one safety countermeasure or another choose to ignore such questions, I do not believe that the public or Government at Federal, State, or local levels will. At least, not for very long.

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