AUTOMOBILE SAFETY REGULATION: TECHNOLOGICAL CHANGE AND THE REGULATORY PROCESS

by

Philip A. Lorang and Lawrence H. Linden

Working Paper MIT-EL 77-036WP

October, 1977

Based upon Research Supported by

DIVISION OF POLICY RESEARCH AND ANALYSIS

NATIONAL SCIENCE FOUNDATION

Under Grant No. OEP 76-00284
ABSTRACT

This report examines the history of automobile safety regulation since 1966, viewed as an attempt to substitute public decisions on the design of new automobiles for private decisions. The focus of the examination is on the problems which confront regulators in the National Highway Traffic Safety Administration (NHTSA) in their attempt to affect the design and performance of automobiles and on the effect regulation has actually had on automotive technology.

Congress gave the NHTSA two ways of bringing about changes in the design and performance of automobiles. The NHTSA may set mandatory performance standards for automobiles and may conduct research and development on new automobile safety technology. Congress did not set a programmed goal that was to be achieved through these methods, however. Instead, the NHTSA must continually decide in an ad hoc fashion the desirability of particular changes in the attributes of new cars. Those that it finds desirable must be forced into practice through standards. The purpose of the agency's R&D is to make possible for the first time additional changes in vehicle attributes which the agency may then choose to force into practice as well.

Several inherent problems in developing the technical requirements in proposals for new standards and in judging the desirability of proposals have not been fully resolved by the NHTSA. They have had a detrimental effect on the number and quality of standards promulgated since the initial set. The agency's efforts in developing new technology have also faced problems and have so far not contributed to its standards.

In order for regulatory action to be taken, policy decisions must be made to compensate for uncertainties in predictions of the impacts of proposed standards. Policy decisions must also be made as to the desirable balance between reductions in traffic risks and increased costs. The uncertainties could be reduced if more reliance were placed on large-scale experimental testing of contemplated safety modifications in actual use. The policy choices that would remain, of both types, could be improved if they were recognized as such and the process for making them opened up to greater outside inspection and participation.
This paper is one of a number of M.I.T. Energy Laboratory Working Papers prepared as part of the Energy Laboratory project "Regulating the Automobile." The project is supported by the Division of Policy Research and Analysis of the National Science Foundation under Grant Number OEP 76-00284. Five efforts comprise the project; (1) an analytical comparison of the three areas of automotive regulation--safety, fuel economy, and air pollutant emissions; (2) examination of the politics of automotive regulation, focusing on why we regulate the way we do; (3) a study of uncertainty in emissions regulation; (4) an analysis of the impact of the fleetwide fuel economy regulations on the structure of the automotive industry; and (5) the particular political history of The Clean Air Amendments of 1970.

The present paper was written in support of the comparison of regulatory regimes.

Acknowledgments are due many individuals from both government and industry who inconvenienced themselves to share their thoughts. Dr. Carl Nash, now of the National Highway Traffic Safety Administration, was particularly kind both in helping to arrange contacts within the NHTSA and in giving his own time and views.

During the course of this work Mr. Lorang was personally supported by the Fannie and John Hertz Foundation as a Graduate Fellow. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of authors and do not necessarily reflect the views of the M.I.T. Energy Laboratory, the Massachusetts Institute of Technology, the National Science Foundation, or the Hertz Foundation.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>2</td>
</tr>
<tr>
<td>PREFACE AND ACKNOWLEDGMENTS</td>
<td>3</td>
</tr>
<tr>
<td>LIST OF TABLES AND FIGURES</td>
<td>7</td>
</tr>
<tr>
<td>CHAPTER ONE</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>8</td>
</tr>
<tr>
<td>1.1. Background and Motivation</td>
<td>8</td>
</tr>
<tr>
<td>1.2. Problem Definition</td>
<td>11</td>
</tr>
<tr>
<td>1.3. Previous Work</td>
<td>15</td>
</tr>
<tr>
<td>References to Chapter One</td>
<td>17</td>
</tr>
<tr>
<td>CHAPTER TWO</td>
<td></td>
</tr>
<tr>
<td>HISTORICAL, LEGAL, AND INSTITUTIONAL BACKGROUND FOR FEDERAL IN Volvement in Automobile Safety Regulation</td>
<td>19</td>
</tr>
<tr>
<td>2.1. The Automobile Safety Problem and the Genesis of Federal Involvement</td>
<td>19</td>
</tr>
<tr>
<td>2.2. The National Traffic and Motor Vehicle Safety Act of 1966</td>
<td>23</td>
</tr>
<tr>
<td>2.2.1. Motor Vehicle Safety Standards</td>
<td>24</td>
</tr>
<tr>
<td>2.2.2. Testing, Research, and Development</td>
<td>31</td>
</tr>
<tr>
<td>2.2.3. Judicial Review</td>
<td>32</td>
</tr>
<tr>
<td>2.3. Continuing Congressional Interest in Motor Vehicle Safety</td>
<td>36</td>
</tr>
<tr>
<td>2.4. The National Highway Traffic Safety Administration</td>
<td>40</td>
</tr>
<tr>
<td>References to Chapter Two</td>
<td>45</td>
</tr>
</tbody>
</table>
### TABLE OF CONTENTS
Continued

#### CHAPTER THREE

**TEN YEARS OF REGULATION: OVERVIEW**

- 3.1 Standards Issued
  - 3.1.1 Initial Standards and Immediate Additions
  - 3.1.2 Minor Subsequent Standards
  - 3.1.3 Major Subsequent Standards
- 3.2 Standard Not Issued
- 3.3 Appraisal

References to Chapter Three

PAGE 47

#### CHAPTER FOUR

**RE-EXAMINATION OF THE OBJECTIVES OF REGULATION**

- 4.1 Programmed Objectives vs. Ad Hoc Decisionmaking
- 4.2 The Economics of Social Desirability
- 4.3 New and Known Technologies and the Process of Technological Change
- 4.4 The Two Objectives of Automobile Safety Regulation

References to Chapter Four

PAGE 71

#### CHAPTER FIVE

**FIRST OBJECTIVE: PUTTING KNOWN TECHNOLOGIES INTO PRACTICE**

- 5.1 The NHTSA Approach to Standards Development
- 5.2 Inherent Problems in Standards Development and Attempts to Resolve Them
- 5.3 Consequences of the Unresolved Problems

References to Chapter Five

PAGE 92

PAGE 128
<table>
<thead>
<tr>
<th>CHAPTER SIX</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECOND OBJECTIVE: GENERATING NEW TECHNOLOGY</td>
<td>131</td>
</tr>
<tr>
<td>6.1 Industry R&amp;D Activities</td>
<td>133</td>
</tr>
<tr>
<td>6.2 The NHTSA's R&amp;D Activities</td>
<td>141</td>
</tr>
<tr>
<td>6.3 Technology Forcing</td>
<td>149</td>
</tr>
<tr>
<td>References to Chapter Six</td>
<td>154</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER SEVEN</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY, CONCLUSIONS AND RECOMMENDATIONS</td>
<td>155</td>
</tr>
<tr>
<td>7.1 Summary</td>
<td>156</td>
</tr>
<tr>
<td>7.2 Discussion and Conclusions</td>
<td>162</td>
</tr>
<tr>
<td>7.3 Recommendations</td>
<td>169</td>
</tr>
</tbody>
</table>
LIST OF TABLES AND FIGURES

TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Initial Safety Standards and Immediate Additions</td>
</tr>
<tr>
<td>3.2</td>
<td>Minor Subsequent Safety Standards</td>
</tr>
<tr>
<td>3.3</td>
<td>Major Subsequent Safety Standards</td>
</tr>
</tbody>
</table>

FIGURE

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>National Highway Traffic Safety Administration Organization Chart</td>
</tr>
</tbody>
</table>
CHAPTER ONE

INTRODUCTION

The purpose of this report is to analyze automobile safety regulation, viewed as an attempt to substitute centralized decisions for private decisions on the design of automobiles.

1.1 Background and Motivation

In 1966, with the enactment of the National Traffic and Motor Vehicle Safety Act, the federal government began a new regulatory effort: the establishment of mandatory standards for the safety of new motor vehicles.

The creation of new federal regulatory regimes had not been uncommon in United States history prior to 1966. Such action had often been the response of Congress to perceived problems that were not being adequately dealt with by private economic activity, the system of common law, or the individual states. Many of the older and better known regulatory agencies and commissions had been involved primarily with economic regulation of market entry, industry concentration, prices, and unfair trade practices. But safety regulation had not been uncommon either. Many of the regulatory agencies whose primary concern was economic regulation had also been active in safety regulation; this was particularly true in transportation. And health and safety regulation in the areas of food
and drugs, insecticides, flammable fabrics, and hazardous substances labeling predated motor vehicle safety regulation. One might thus conclude that the regulatory effort begun in 1966 had well-established precedents.

But the National Traffic and Motor Vehicle Safety Act created a regulatory regime that was different from most earlier regimes in important ways. The older programs of health and safety regulation were primarily restrictive in the way they dealt with harmful products and technologies. They sought to protect public health and safety by prohibiting the conduct of certain activities and the sale of certain types of products. Only in a few areas of regulation, for example air, rail, and pipeline transportation, was the use of well-known safety technology made a precondition to entry and operation in a regulated market. Under, for example, the Food, Drug, and Cosmetic Act the federal government prohibits the marketing of drugs which are considered unsafe. It generally leaves to private action the discovery and development of substitute drugs which are safe.

In contrast, the 1966 Act was intended by its sponsors and supporters to induce technological change towards greater safety in a product rather than simply to restrict the sale of unsafe products or to require the use of established safety technology. The Act created the institutions and tools by which the federal government could play an active and continuing role in inducing changes in motor vehicle design in particular desirable directions rather than simply blocking off certain undesirable directions. The sponsors and supporters of the Act had in mind the
immediate, forced incorporation into all new automobiles of a particular set of safety features that had previously seen only scattered use. They also envisioned regulation on other types of motor vehicles and safety changes that would come from beyond the contemporary state of the art.

In retrospect the 1966 Act, together with the 1965 Motor Vehicle Air Pollution Control Act, was a momentous step in the history of the American automobile industry and its relationship with the federal government. For the first time, a federal agency could accomplish changes in many aspects of the design and performance of all automobiles. Emissions standards for automobiles had been promulgated under the 1965 law several months before passage of the National Traffic and Motor Vehicle Safety Act, but they were relatively mild and restricted in scope. The provisions of the 1966 Act allowed standards affecting many more aspects of design and performance.

The automobile industry is one of America's largest and most concentrated and its products are used daily by a hundred million Americans. Of the earlier health and safety regulatory programs, only food and drug regulation had the potential for affecting as important an industry as this one. Automobile safety regulation can thus be viewed as a significantly novel attempt to consciously control by central decision the design and performance of the products of a key industry without regulating the industry itself. The new regulatory regime was a departure from both past federal policies of laissez-faire towards the automobile industry and the government-sanctioned cartels that were frequent in other programs of regulation. Regulation of automobile safety was a
major and early entrant in a category of regulation that has since grown to include occupational health and safety, automobile fuel economy, consumer product safety, and a wide variety of environmental regulations.

1.2 Problem Definition

Intention and the enactment of an enabling law are only the first steps in a program of regulation, however. Regulation intended to prod firms still run by private individuals into changing the technology of their products requires that regulatory decisions much like the original decision to regulate be made more or less continuously. Standards must be developed, promulgated, and enforced. The day-to-day and year-to-year administration of a regulatory program can become as important in determining its effects on the target products as the enactment or exact wording of the act which established it.

Thus this report will review, analyze and critique the continuing federal effort to induce changes in the design and performance of automobiles towards greater safety. The rationale for beginning the regulatory regime will not be examined in any detail. Instead, the emphasis will be on the regulatory process once begun and the effects it has actually had on automobiles. The intent is to examine what has been accomplished and what has not, and why. Automobile safety regulation offers an opportunity to study what happens once the mechanisms for partial collectivization of design decisions are established for a product whose characteristics and role have been found to be so important as to warrant the establishment of such mechanisms.
Automobile safety regulation is singled out from the broader area of motor vehicle safety regulation established by the 1966 Act and administered by the National Highway Traffic Safety Administration. It is appropriate to do so, since the sponsors and supporters of the 1966 Act were clearly most concerned with the safety of passenger automobiles. Before leaving other classes of motor vehicles behind, however, it is worth noting that the history of regulation for these other classes is interesting in its own right. It does, however, present a different topic as the nature of the regulated industries and the roles of their products are much different.

The six chapters which follow analyze the process and accomplishments of slightly more than a decade of automobile safety regulation, both in comparison to the intentions and expectations of 1966 and on their own merits, apart from what might have seemed possible or desirable in 1966.

Chapter 2 very briefly reviews the history that led up to the passage of the National Traffic and Motor Vehicle Safety Act in 1966. The chapter also summarizes relevant portions of the Act, discusses the role of judicial review of agency-administered regulations, and gives a short description of the National Highway Traffic Safety Administration. Chapter 2 is included as background for readers unfamiliar with automobile safety issues. Readers who are familiar with the area and with administrative procedures for federal regulation are urged to skip the chapter.
Chapter 3 gives an overview of the history and content of the safety standards for automobiles which have been issued to date and of some that were proposed but not issued. This chapter also is intended primarily as background, although it does give a preliminary appraisal of the effect the standards have had on automotive technology relative to some of the expectations that were evident in 1966.

A characteristic of these early expectations was that they were not all very well formulated. The struggle in 1966 was to establish a federal program of regulation; the goals of the program suffered in their clear expression from the necessities of political symbolism, compromise, and legislative obfuscation. Chapter 4 therefore re-examines what the objectives of a regulatory program aimed at at least a partial substitution of centralized direction for market and private decisionmaking could and should be. The chapter interprets the program as having two objectives, both of which can be considered to be forms of technological change. The first is to force into use socially desirable changes in design and performance which could be but have not been adopted by private decision; the second is to find new technologies which might make possible for the first time additional desirable changes. Chapter 4 also discusses the concepts of social desirability and technological change.

Taking as given this interpretation of the NHTSA's goals, Chapters 5 and 6 review and analyze how the National Highway Traffic Safety Administration has gone about achieving the two objectives. Chapter 5 deals
with the first objective. It reviews the process of developing safety standards, the problems that arise in development, and the consequences of the unresolved problems for the process and results of regulation. Chapter 6 is concerned with research and development, the technology-discovering portion of the regulatory program. Since industry R&D has kept its dominant role through the last ten years the chapter analyzes the incentives and disincentives for the industry itself to work towards the second objective. It then recounts and appraises the government's efforts in the same direction. Chapter 6 also discusses "technology forcing" — requiring by law or standard levels of performance which can be achieved by industry only if it expends its own resources on finding new technologies — as a method of generating new technology. Technology forcing has not seen use in automobile safety regulation but its use in automobile emissions regulation makes it a necessary part of any discussion of safety regulation.

Chapter 7 summarizes very briefly the points made in earlier chapters about the last ten years of automobile safety regulation. It makes some conclusions about what that history implies about attempts to replace private decisions with public decisions. Chapter 7 ends with some recommendations for improvements in the process of regulation which may help improve its results as well.
1.3 Previous Work

The study of automobile safety has not been a neglected activity. Automobile safety regulation is important for two reasons. One is that the problem it addresses — traffic injuries and fatalities — is immense in its impact on the nation. Over 45,000 traffic deaths and millions of disabling injuries are suffered each year. The economic costs of motor vehicle accidents have been estimated as low as $15.8 billion and as high as $46 billion per year. Either figure represents a significant fraction of the total costs of automotive transportation. The second reason is that, like almost everything involved with the huge automobile industry and the national automobile fleet, automobile safety regulation affects the allocation of large amounts of social resources. Passenger car buyers paid an estimated $14.5 billion for federal safety requirements as part of the prices of 1966 to 1974 cars. The manufacturers presumably bore additional costs they were unable to recover from buyers. It is not surprising that considerable attention has been given to the subject of automobile safety, given the size of the stakes involved.

While some scholarly interest in automobile safety was shown during the first few years of automobile safety regulation, other forms of regulation have since diverted most of this attention. The published results of the early attention concerned the welfare economics of the decision to replace market mechanisms with regulation and the politics of the decision as it was made by Congress. This work came too early to have dealt with the process of regulation once the decision to do so had
been made. The study and debate about the ongoing process of automobile safety regulation has been left primarily to the participants in the regulatory process itself: the automobile manufacturing and related industries, the insurance industry, the three branches of the federal government, institutionalized consumer and public interest groups, and consultants and contractors to each. These participants have produced a very large literature on automobile safety. The vast majority of the literature is technical and addresses the problem of automobile safety rather than the process of automobile safety regulation. Most of the remainder that does address the regulatory process tends to be advocative rather than analytic, although it does contain much relevant information and many insights. Some of the more important works are listed as references to this chapter. 10-19
REFERENCES TO CHAPTER ONE


2. P. L. 89-272, Title II.


CHAPTER TWO

HISTORICAL, LEGAL, AND INSTITUTIONAL BACKGROUND FOR

FEDERAL INVOLVEMENT IN AUTOMOBILE SAFETY REGULATION

Readers who are not familiar with the history of automobile safety regulation should find the background material presented in this chapter useful in following the discussions in later chapters. Persons who have been involved with this particular form of regulation will find that this chapter contains no surprises for them.

2.1 The Automobile Safety Problem and the Genesis of Federal Involvement

The commonly accepted division of the causes of traffic fatalities and injuries is into three categories: the performance of the driver, the design and performance of the vehicle, and the "environmental" conditions of highway design, traffic pattern, weather, etc. The interactions and relative importance of the three aspects are subtle and difficult to quantify or measure, and are subjects of continuing dispute. But clearly each of the three is capable of affecting to some degree both the likelihood that a given trip will result in an accident and the injury that results from an accident if one occurs. The "automobile safety problem" concerns only the role of the vehicle. The other two factors are usually thought of as together comprising a "highway safety problem".

19
The elements of automobile safety have traditionally been separated into three categories. Accident avoidance, or crash avoidance, covers those aspects of vehicle design and performance that affect the likelihood of accidents of different severity levels, with severity defined in terms of vehicle mechanics. Braking, steering handling, stability, lighting and signaling, driver field of view, control layout, etc. are in this category. Crashworthiness covers those aspects of vehicle design and performance which affect the injury that occupants, and other persons such as pedestrians, receive in an accident of a given type and severity. Occupant restraint systems, vehicle structural characteristics, and interior compartment design are some of the factors in this category. Aspects which affect the safety and recovery of occupants and others after an accident has occurred and the initial injuries have been sustained are termed postcrash. Susceptibility to postcrash fire and the ease of occupant removal for medical treatment are in this last category.

It was only recently that it became accepted that there was a "national automobile safety problem" that would require or respond to federal involvement. Traffic fatalities have accompanied motorized personal transportation from its birth near the end of the last century. And in the earlier years of the industry, when the basic design of automobiles was far from standardized, manufacturers advertised the innovative safety features of their products -- features that were often as necessary for comfortable driving as for safe driving.¹ But when most automobiles were able to stop reliably under normal conditions and had low centers of gravity and rigid all-steel bodies, the role of the
vehicle itself in traffic fatality and injury causation came to seem not as important as the role of the driver. Of the two the driver was clearly the least reliable. And in the early years, the condition of most roadways was also poor compared to the seemingly advanced design of automobiles. It was thus reasonable that public and private efforts might have been and in fact were focused on driver training and licensing, traffic law enforcement, and road construction and improvement for most of the first half of the twentieth century. Since state and local governments were traditionally responsible for police functions, motor vehicle registration, and public roads, federal involvement in these efforts was minimal.

In the late 1940s and early 1950s an awareness developed among medical practitioners, state traffic safety officials, and a few state and federal legislators that the design of an automobile could be a significant causal factor in the production of injuries during an accident. The automobile manufacturers also were aware of the causal relation, and of some design approaches for mitigating injuries. The Ford Motor Company used a crashworthiness-oriented advertising campaign and a package of safety options to promote its 1956 model line, with disputed success.* Public awareness began to grow and concerned individuals and groups began urging the manufacturers to adopt known crashworthiness designs.

* The industry folklore is that the Ford safety campaign was a failure that damaged overall sales and was abandoned for that reason. Some observers of the industry dispute this, contending that sales of Fords were down in 1956 because of their styling defects and citing figures to show that the safety package itself sold well.
The automobile manufacturers did not continue the Ford approach to safety promotion, and automobile safety gradually became an item on the political agendas at various levels of government. The subsequent history is complex, and documented well elsewhere. Briefly, the automobile manufacturers resisted attempts to make a political issue of the design of their products and opposed each step of regulation as it came. Some voluntary product changes were reluctantly made. But by the late 1950s, crashworthiness was an issue in several state legislatures, promoted vigorously by New York State Senator Edward Speno. By the early 1960s Congressman Kenneth Roberts, who had been advocating a federal involvement since 1956, had succeeded in getting mandatory federal standards issued for the performance of brake fluids and seat belts. In 1964, the General Services Administration (GSA) was given statutory authority to set safety standards for automobiles purchased by the federal government; it was hoped that this would encourage the manufacturers to adopt safety features on the rest of their production. In 1965 activity in Congress intensified with some dramatic subcommittee hearings in the Senate. In November of 1965 Ralph Nader published Unsafe at Any Speed. The book increased public awareness not only of crashworthiness issues but also of accident avoidance problems by detailing the allegedly unsafe handling characteristics of the early Corvairs.

In 1966 the National Traffic and Motor Vehicle Safety Act was passed by unanimous vote in both Houses of Congress, a rare event that illustrates how successfully the political line had been drawn between those in favor of halting the "carnage on the highways" and those opposed.
Very few Congressmen were opposed, and none were for the record. A companion act, the National Highway Safety Act, was also passed in 1966 opening a major role for the federal government in the other areas of traffic safety that had traditionally been the responsibility of the states.

2.2 The National Traffic and Motor Vehicle Safety Act of 1966

Congress gave recognition to the distinction between accident avoidance and crashworthiness by declaring twin purposes for the National Traffic and Motor Vehicle Safety Act of 1966 (hereinafter the Safety Act): to reduce traffic accidents and to reduce deaths and injuries from traffic accidents. Title I of the Act has four main provisions relevant to the regulation of new motor vehicles: provisions for the establishment of Federal motor vehicle safety standards (MVSS) by the Secretary of Transportation, for mandatory manufacturer notification to owners of vehicles with newly discovered safety defects, for government-conducted and supported testing, research, and development, and for a consumer information program whereby manufacturers would be required to furnish information on the safety performance of competing new car models. Title II deals with new tire safety. It calls for the establishment of a uniform grading system for tire quality and specifies in more detail the content of any safety standards for new tires.

* The Act as passed put the new regulatory program under the Secretary of Commerce. The Secretary of Transportation was given responsibility for the program very shortly after passage of the Act.
The tire safety, defect notification, and consumer information provisions of the Safety Act are not of particular relevance to following chapters and will not be elaborated here. The details of the statutory provisions for the establishment of safety standards and for research and development are, on the other hand, very important to understanding the history of the Act's implementation. The following two subsections therefore discuss in some depth these two provisions. A third subsection explains the statutory provisions for and the importance of judicial review of newly issued safety standards.

2.2.1 Motor Vehicle Safety Standards

Content of Standards

Federal motor vehicle safety standards may regulate either complete motor vehicles or individual items of motor vehicle equipment. The Safety Act places five restrictions on the content of standards. A standard must be "stated in objective terms" and provide "objective criteria"; it may prescribe only minimum levels of vehicle or equipment "performance", not the design details of how that performance will be obtained; it must be "practicable"; it must be "appropriate"; and it must "meet the need for motor vehicle safety", defined in the Act as the protection of the public from "unreasonable risks associated with motor vehicle design and performance." These are the five necessary conditions for the legal validity of a motor vehicle safety standard; at one time or another, each has been used to challenge a standard in court. The conditions merit fuller discussion.
The requirement that a standard be objective and provide objective criteria has been interpreted to mean that compliance tests must be repeatable and not open to personal interpretations. In an industry with a long cycle of planning and tooling before production begins, like automobile manufacturing, manufacturers must be able to assure themselves at the prototype stage that their final products will comply with federal standards if tested by the government. There must be criteria in the standard which allow both manufacturer and government testing to reach the same conclusion as to whether a vehicle in question meets the requirements of a given standard. The compliance testing procedure specified in a standard necessarily becomes the crucial determinant of the standard's actual requirements, since legal action will be based on the results of that test procedure. Requirements that are not objectively stated are essentially unenforceable. A few existing MVSSs contain such unobjective requirements; MVSS 108, for example, requires certain spacings to be as far apart as practical. 12

The restriction that federal motor vehicle safety standards specify only performance and not design was intended by its drafters to ensure that federal standards did not inhibit innovative designs by freezing existing designs into place. Congressional preference for performance standards is of long standing. Several other product safety laws before and since the Safety Act have favored performance standards, though not always as unconditionally as the Safety Act does. 13 It is worth noting that the avoidance of design-type standards has never been absolute under the Safety Act, either in practice or in law. The precise distinction
between design and performance requirements is not always clear, and standards have been in effect with provisions that could easily be interpreted as specifying design approaches if not actual design details, rather than performance. And in one case of judicial review, the court decided that the provisions of the Safety Act did not constitute an absolute ban on all design standards. The court ruled in that case that where the stifling effect on innovation was minor and the design restriction was necessary to the safe performance of a vehicle, it was not inconsistent with Congressional intent for the standard in question to specify dimensions and tolerances, details that were undisputedly design in nature.14

The meaning of the requirement that standards be practicable has been an important point of dispute. The automobile manufacturers' trade association tried but failed to get more specific language on lead time, customary model changes, and commensurability of costs and safety benefits included in the Safety Act instead of the vague practicability language.15 The Senate Commerce Committee went so far as to state only that while it wanted safety to be the overriding consideration in the issuance of standards, it recognized that the Secretary would necessarily consider reasonableness of cost, feasibility, and adequate lead time. At a minimum, practicability seems to require that compliance with a standard be technically feasible by its effective date, even though achieving compliance by that date may be a burden or even a hardship on a manufacturer. Congress did not contemplate that the manufacture of automobiles would be halted because a safety standard could not be met. Beyond this,
there is no universally accepted meaning to the practicability requirement.

The meaning of the requirement that a standard be appropriate is that a standard must be drafted with consideration given to the particular characteristics of the item it regulates. The drafting committees did not intend that such widely varying types of vehicles as luxury cars, compacts, convertibles, and sports cars would have to meet identical performance standards. The appropriateness requirement essentially places a burden on the Secretary to show that a standard which places identical requirements on two different types of vehicles meets the conditions of practicability and satisfies the need for motor vehicle safety when considered for each vehicle type separately. There is no assumption that a valid standard for one type of vehicle is still valid when extended to another type without modification. In particular, review courts have in effect given convertibles, sports cars, and retreaded tires protected positions among motor vehicles and tires; safety standards are not permitted to force these classes of products out of production by imposing upon them requirements identical to those for other vehicles or for new tires which they by their nature cannot meet or which would raise their cost so much as to make them unsalable.16,17

Finally, the requirement that standards meet the need for motor vehicle safety puts both upper and lower bounds on standards. On the one hand, Congress intended that the standards set by the Secretary actually achieve reductions in traffic injuries and fatalities. Standards that do not increase safety do not meet the intent of Congress in passing the
Safety Act. For example, a standard intended only to reduce repair costs would not be allowed as a motor vehicle safety standard. On the other hand, not all risks associated with motor vehicles are necessarily unreasonable and the Safety Act associates motor vehicle safety only with protection from unreasonable risks. Standards can be and have been challenged in court on the grounds that the risk being reduced by a standard was already so small as to not be unreasonable. 18

Secretary's Initiative

The Safety Act required the Secretary of Transportation to issue initial safety standards within four months of its enactment. Beyond this requirement, the decision to issue further standards was left to the Secretary's initiative. A requirement that the set of standards be updated at least every two years was deleted from the Senate version of the bill before the law was passed.

There has been some speculation voiced that the Safety Act requires the Secretary to promulgate a standard if he officially finds that it meets the five necessary conditions discussed above. The question has never been before a court for decision.

Procedure for Issuing Standards

The Safety Act specifies that the Administrative Procedure Act governs the issuing of safety standards. Because of the nature of standards as rules of general applicability, the Administrative Procedure Act allows "informal" rulemaking procedures for their promulgation. The procedural requirements in informal rulemaking are minimal. An agency may, if it chooses to do so, begin the rulemaking proceeding with an
advance notice of proposed rulemaking (ANPRM) published in the Federal Register; the content of an ANPRM is not set by law, but agencies usually use one as a general announcement of agency action in a particular area and as a request for comments and information relevant to that area. The rulemaking proceeding officially begins with the publication of a notice of proposed rulemaking (NPRM) in the Federal Register. The NPRM must explain the purpose of the rulemaking and the subject matter under consideration. This explanation is supposed to alert potentially affected parties as to the questions at stake in the rulemaking. The most common and direct way of doing this is to publish the full text of the proposed regulation or standard or the text of each alternative under consideration. After the NPRM is published, the rulemaking agency must allow interested persons to submit written comments into a public docket of the proceeding. A final rule is published in the Federal Register after the agency has considered the comments received. Interested persons must be given the right to petition for reconsideration of any final rule.

The intervals between the publication of the NPRM, the closing of the public docket to further comments, the issuance of the final rule, and the deadline for petitions for reconsideration may be set by the agency in charge of the rulemaking. At the option of the agency, oral as well as written comments may be heard, or a "formal" rulemaking procedure involving a trial-like public hearing may be followed instead. The advantages to an agency of informal rulemaking are such that agencies rarely choose formal rulemaking. Formal rulemaking has been used only
Once in the development of motor vehicle safety standards; that proceeding was terminated by the officials in charge before it reached its conclusion. 20

The Safety Act provides for judicial review of new safety standards in a U.S. court of appeals. Any adversely affected person may petition for review of a standard within sixty days after the standard is issued. Judicial review is discussed in more detail in Section 2.2.3.

**Enforcement**

Manufacturing, selling, etc. a vehicle or item of equipment which does not comply with applicable federal motor vehicle safety standards is prohibited by the Safety Act. But the Safety Act does not provide for prior compliance testing by the Secretary of Transportation. Instead, manufacturers of vehicles and equipment are required to certify that each of their products complies with all applicable motor vehicle safety standards. Selling a vehicle or item of equipment that has not been certified is prohibited. Certifying a vehicle or item of equipment as being in compliance without exercising due care to ensure that the certification is accurate is also prohibited. Testing by the government is intended to detect violations of these provisions, not to give pre-market approval to new vehicles and equipment.

The Safety Act established fines for violations of these prohibitions. In addition, U.S. district courts are given the authority to restrain violations of the Act. Criminal penalties for violations were proposed on the floors of both Houses of Congress during debate on the bill, but were defeated in each.
2.2.2 Testing, Research, and Development

The drafters of the Safety Act recognized that a program of regulation as envisioned in the Act would require a parallel program of testing, research, and development. First, in order to detect violations of the Act, the government would need to have the facilities and manpower to conduct compliance tests on vehicles purchased for that purpose. The Act authorized the acquisition of such facilities, conditioned on subsequent approval by the relevant congressional committees, and directed the Secretary to begin planning for them. Second, the government would need to develop its own expertise in automotive technology, and would have to create an entirely new technology of safety regulation, to be able to write effective standards. To satisfy this need, the Safety Act gives the Secretary broad authority to conduct research and development both by the government itself and through grants and contracts.

An important historical point is that some of the supporters of the Safety Act believed that the American automobile manufacturers had not been pursuing safety-related R&D as aggressively as they should have been prior to 1966. The provision for a broad government R&D program was intended in part to stimulate more effort on the part of industry. Ralph Nader had charged in Unsafe at Any Speed that the manufacturers had used their dominant position in the industry and in the automotive engineering profession to actively discourage advances in safety technology. Nader and like-thinking safety advocates wanted an independent federal R&D program which could be used as a yardstick by which to measure the
R&D efforts of the manufacturers. The statutory provisions reflect this desire on their part.

2.2.3 Judicial Review

As stated earlier, the Safety Act allows adversely affected persons to petition for judicial review of a new safety standard in a court of appeals. It would be difficult to overstate the importance of the judicial review provision and the role of the courts under it. Just as in a safety standard it is the exact details of the compliance testing procedure which determine the effective content of the standard, so in rulemaking under the Safety Act it is judicial review which determines what type of standards the Secretary is effectively allowed to issue. The five restrictions discussed in Section 2.2.1 take on meaning and become compelling only because review courts have the power to invalidate standards that do not meet them.

Judicial review of informal agency rulemaking is an intricate and evolving area of administrative law. The treatment here will necessarily be simplistic and sketchy.22

The Safety Act itself only states that the "court shall have jurisdiction to review the order in accordance with Section 10 of the Administrative Procedure Act and to grant appropriate relief as provided in such section." The referenced section of the Administrative Procedure Act directs a reviewing court to set aside agency actions, findings, and conclusions if it finds certain defects with them. In normal situation, i.e., situations where an agency has not violated constitutional provi-
sions or exceeded the authority granted by statute, there are three important defects which may lead to reversal of agency action by a review court: (1) the action may not be arbitrary, capricious, or an abuse of discretion; (2) it must have observed procedures required by law; and (3) it must be supported by substantial evidence if the case arose from formal rulemaking or if the case is "reviewable on the basis of a record of a hearing provided by statute." In cases in which all three of these conditions apply, judicial review is said to use a "substantial evidence" standard of review. In cases in which only the first two apply, review is said to use an "arbitrary and capricious" standard of review.

Traditionally, an arbitrary and capricious standard of review meant that a review court would not probe the substantive basis for the factual determinations on which an agency based its actions; instead the court was only to review whether the agency had acted with rationality and consistency. In contrast, a reviewing court using a substantial evidence standard was obligated to determine whether the factual findings of an agency were adequately supported by evidence in the record of the agency proceeding. The substantial evidence test was thus more probing of the evidentiary basis for the agency's findings. It did not require that only the single conclusion made by the agency be possible on the basis of the evidence; two inconsistent conclusions might be supported by substantial evidence in the same record.

Also traditionally, the substantial evidence standard applied only in cases of review where formal, trial-like hearings were the means used by the agency to collect the factual evidence used in its decisions.
Informal rulemaking, which relies on a variety of sources for the information used in developing a rule, was not considered to be subject to substantial evidence review but instead was reviewed under an arbitrary and capricious standard. The rationale for this difference was that formal rulemaking produced a record of evidence that had been tested in cross examination and was hence in a suitable form for a court to review, while informal rulemaking tended to produce a disjointed record of untested statements that were not suitable for factual review.

Legal traditions change, however, and recently some courts have interpreted the two standards of review to be very much alike in practice, with both requiring the review court to examine the substantive evidence supporting agency determinations. In addition, the Supreme Court has implied that even informal rulemaking is to be reviewed with a substantial evidence standard, though most courts of appeals that have reviewed motor vehicle safety standards have professed to be applying an arbitrary and capricious standard. While the question of the appropriate standard of review is not yet settled, a review court will generally not take for granted that all agency findings have been made correctly, but will examine both the process of consideration followed by the agency and the evidentiary basis for the conclusions it reached.

When a safety standard is challenged in court, the Secretary of Transportation has at least the duty to convince the court that the factual determinations that were the basis for issuing the standard were not arrived at arbitrarily; if the particular court favors substantial evidence review the Secretary must as well show that the record of the
rulemaking contains substantial evidence for those factual determinations. This duty on the part of the Secretary does not, however, necessarily require him to prove that each of the five restrictions on the content of the standard have been met. Not all of those restrictions are factual in nature. Some of them are requirements that the Secretary make and state policy choices. Policy choices are always to be reviewed only under the arbitrary and capricious standard. The court may ask only whether the policy choices were rationally connected to their factual basis.

In particular, the requirement that motor vehicle safety standards meet the need for motor vehicle safety requires that a policy decision be made as to what constitutes unreasonable risk associated with motor vehicle performance and design. The answer to that question is a matter of law or policy, not of fact, and the Safety Act in effect leaves it to the Secretary to make the law. Similarly, the "reasonableness of cost, feasibility, and adequate lead time" which the Secretary must consider also has policy components. On the other hand, whether a standard regulates performance as opposed to design and whether it is stated in objective terms are much more factual in nature. The estimated cost of complying with a standard and the potential reduction in injuries it might achieve are also likely to be treated as factual questions. The purpose of judicial review is to serve as a check on the accuracy of factual findings such as these that may be claimed to be support for policy choices and on their adequacy to support the rationality of the policy choices embodied in a safety standard.
2.3 Continuing Congressional Interest in Motor Vehicle Safety

Although the Safety Act has remained as the most important expression on Congressional concern for motor vehicle safety, Congress has shown a continuing interest during the years since 1966. This interest has not been as unanimously supportive of the federal role in motor vehicle safety regulation as the vote on the Safety Act in 1966, however. Instead, there has been mixed support for regulation, criticism of the performance of the Secretaries of Transportation and their delegates, and reluctance to fund the regulatory program as completely as was originally envisioned by the Safety Act supporters.

The Safety Act has been amended by every Congress since its passage, for a total of five sets of amendments to date. Most of these have been strengthening or perfecting amendments, initiated by the recognition of shortcomings in the original Act. Some of them have been examples of Congressional disapproval of the decisions of the Secretary and his delegates.

In 1968, provisions were added to require the Secretary to temporarily exempt very low volume manufacturers from standards in cases of financial hardship or cases involving research or experimental vehicles. In 1966 the supporters of the Safety Act had been primarily interested in regulating the products of the mass manufacturers. The standards issued under the Act had proven to be inappropriate when applied to newly manufactured replicas of old car models and to other custom cars. The testing requirements of the standards, particularly the destructive testing of several vehicles, were also said to be a hardship for manufacturers who produced only a few hundred vehicles per year.²³
In 1970, the definition of motor vehicle equipment was expanded to include some items which the Department of Transportation felt needed to be included in the list of items subject to regulation. Motor vehicle tires were added to the defect and notification provisions, which had previously applied only to complete vehicles. The consumer information provision was clarified to ensure that prospective purchasers as well as actual purchasers would be able to get information from manufacturers on the safety performance of competing models. And a provision was added which required manufacturers to keep records on the purchasers of their products, so that defect notifications would be possible.

In 1972, the exemption provisions added in 1968 were substantially revised. The 1968 amendment had allowed temporary exemptions only for manufacturers with volumes of less than 500 vehicles per year. The 1972 amendments increased this volume to 10,000 vehicles per year in cases of financial hardship. The 1972 amendment made possible temporary exemptions for mass produced specialty vehicles like taxi cabs, funeral hearses, some recreational vehicles, etc. In addition, the 1972 amendment expanded the exemption privileges for research and experimental vehicles.

In 1974, the Safety Act was strengthened in several ways. Manufacturers were required to notify present owners of vehicles with safety defects, rather than only first purchasers. They were also required to remedy defects without charge; previously they had usually done so but only voluntarily. The list of actions prohibited by the Act was expanded to include various record keeping and reporting failures. The maximum
The civil penalty for violations was doubled. The Secretary was given authority to investigate traffic accidents, including authority to impound and examine vehicles as needed to determine the causes of an accident. Finally, the Secretary was given authority to require manufacturers who opposed proposed or final regulations on the grounds of the cost of complying to furnish him with the cost data supporting their claims.26

The 1976 amendments were not substantive; they affected only the NHTSA's budget authorization.27

Congress has not been entirely satisfied with the way the Secretaries have administered the Safety Act. This dissatisfaction has been expressed in law several times. In the amendments of 1970, over the Secretary's protest, Congress set a deadline for the issuance of a safety standard for retreaded tires. In 1974 it did the same for eight aspects of school bus safety. In the same year it ratified into law a standard that the Secretary had recently established for the crash integrity of vehicle fuel systems and prohibited him from amending it towards lower safety performance. This was the outcome of dissatisfaction with the pace of the rulemaking in this area and a desire to preclude a delay in the effective date of the standard and possible weakening of its requirements. Also in 1974, the Safety Act was amended to require the Secretary to respond affirmatively or negatively within four months to all petitions for the start of a rulemaking or defect investigation procedure. Previously, there was no deadline for the Secretary to respond to petitions. The amendment as originally introduced into the
House would have allowed petitioners whose petitions were denied by the Secretary to file suit in a district court for a de novo trial of the merits of their petitions. This stronger version better showed the dissatisfaction of the amendment's sponsors with the priorities set by the Secretary.28

In addition to amendments to the Safety Act, oversight subcommittees in both the House and Senate have repeatedly urged the Secretary and his delegates to be more vigorous, both in motor vehicle safety regulation in general and in particular areas of rulemaking.

The most notable example of divergence between the Secretary and Congress was one in which Congress reversed an existing safety standard rather than pressured for a new one. This occurred in October 1974, when the amendments to the Safety Act repealed a portion of a standard which required ignition-seat belt interlocks on model year 1974 and later automobiles. At the same time, Congress put a new provision into the Act specifying the use of more elaborate administrative procedures than normal in any future rulemaking aimed at requiring occupant restraint systems other than conventional seat belts. Congress also retained for itself the right to overrule the result of such a rulemaking by joint resolution.

The Secretaries of Transportation have been less than completely successful with the committees that appropriate funds for the administration of the Safety Act. The compliance testing and R&D facility which the Secretary was authorized to plan and acquire has never received approval and funding. Consequently the Department of Transportation does
not have all the in-house technical expertise, manpower, and facilities that were envisioned in 1966 by the supporters of the Safety Act. Instead it relies heavily on contracts with independent testing labs, highway research institutes associated with several universities, other government agencies, and private consultants. The Department does lease some building and test ground from the State of Ohio for use in defects testing. In addition it operates the Safety Research Laboratory, once part of the National Bureau of Standards. Congressional appropriations committees have refused to fund at least one major research project, for the installation of crash recorders in a large fleet of automobiles.

2.4 The National Highway Traffic Safety Administration

The National Traffic and Motor Vehicle Safety Act of 1966 gave the responsibility for issuing and enforcing safety standards to the Secretary of Commerce and established the National Traffic Safety Agency within the Department of Commerce to assist the Secretary. The companion National Highway Safety Act established the National Highway Safety Agency, also within the Department of Commerce, to administer programs of federal assistance and direction of state efforts in safe highway maintenance and operation, traffic law enforcement, driver registration and training, etc. When the Department of Transportation was created shortly after passage of the Acts, the Secretary of Transportation was given the role originally assigned to the Secretary of Commerce and the two agencies were transferred to the new Department and redesignated as
Bureaus. Within months they were combined by executive order into a single National Highway Safety Bureau under the Federal Highway Administration. In 1970 the Secretary of Transportation, with the consent of Congress, elevated the Bureau to the status of a separate operating administration within the Department of Transportation. The Bureau was given its present name, the National Highway Traffic Safety Administration (NHTSA). The Administrator of the NHTSA is a political appointee responsible to the Secretary.*

The Secretary has delegated to the Administrator of the NHTSA his responsibilities under the National Traffic and Motor Vehicle Safety Act, the National Highway Safety Act, and the Motor Vehicle Information and Cost Savings Act.29 The NHTSA is also responsible for the administration of mandatory fuel economy standards under Title III of the Energy Policy and Conservation Act of 1975.30 Thus motor vehicle safety regulation is only one of many responsibilities of the NHTSA. Within motor vehicle safety, setting standards for new automobiles is also only one of many of the NHTSA's responsibilities. The NHTSA sets standards for other vehicle classes, such as trucks, buses, and motorcycles. It also operates programs of standards enforcement and defect investigation for all vehicle classes.

Figure 2.1 shows the most recent NHTSA organization chart.31 The NHTSA has undergone several reorganizations and will no doubt continue to

* For convenience, the name "NHTSA" will be used to refer to both the NHTSA itself and its predecessors, and for the Secretary of Transportation when discussing duties that have been delegated to the Administrator of the NHTSA by the Secretary.
do so. To date, however, each reorganization has left intact three key program offices: the Offices of Motor Vehicle Programs, Traffic Safety Programs, and Research and Development. The Office of Traffic Safety Programs is concerned with administering the programs of federal aid to states under the National Highway Safety Act; it has no activities relating to safety standards for new vehicles. The Office of Motor Vehicle Programs administers the safety standards, compliance, and defect programs. The Office of Research and Development administers the R&D program which provides technical support for both the Motor Vehicle Programs and Traffic Safety Programs Offices. The Office of Research and Development also conducts and contracts for NHTSA R&D programs that are not specifically in response to expressed needs of the other two program offices. The Office of Automotive Fuel Economy is a recent addition; it administers the NHTSA's responsibilities under the Energy Policy and Conservation Act. In addition to these four program offices the NHTSA has various other offices responsible for program direction and coordination and for staff and administrative support services, as shown on the organization chart. The NHTSA also has regional offices that serve mainly as liaison with state highway and traffic safety agencies and as public affairs representatives.

The NHTSA is a relatively small agency. Its budget authority is about that of the Federal Communications Commission, the Securities Exchange Commission, or the Interstate Commerce Commission. Its staff is one-tenth as large as that of the Environmental Protection Agency. The Food and Drug Administration also dwarfs the NHTSA, both in staff and
FIGURE 2.1
National Highway Traffic Safety Administration
Organization Chart
In fiscal year 1977 the NHTSA had 918 authorized positions in its staff and had a total program level of about $218 million. But $129 million of this amount consisted of grants to state and local governments for highway safety programs. The Office of Motor Vehicle Programs had a staff of about 200. The NHTSA's entire contract program for both vehicle and other research was about $32 million. In-house R&D expenses, including contract monitoring, came to about $5 million.33
REFERENCES TO CHAPTER TWO

1. See, for example, advertisements reproduced in 1975 NHTSA Annual Report, DOT-HS-801 910, pp. 3,4.


12. 49 C.F.R. 571.108, Table II.


REFERENCE TO CHAPTER TWO
Continued


21. See generally Chapters 5 and 6 of Unsafe At Any Speed.


28. H. R. 5529, 93rd Cong.


30. P. L. 94-163, Title III.


In 1966 there was a range of expectations held as to what the new regulatory regime would accomplish. The intention of some safety advocates was that federal regulation would correct the failure of the automobile manufacturing industry to build safer cars. Changes in the design and performance of automobiles were to be forced upon the manufacturers through federal motor vehicle safety standards. Traditional industry practices, which had allegedly subordinated safe design to considerations of acceleration performance and style, were to replaced at least in part by safety standards designed by an expert regulatory agency. Not all of the congressmen who voted in favor of the 1966 Safety Act shared this expectation of recurrent product changes planned by bureaucrats and executed by industry. It would not be unreasonable to suppose that many congressmen viewed the 1966 Safety Act primarily as a way to get a limited one-time improvement in automobile safety rather than as the start of a vigorous and continuing program of federal intervention in industry design practices.

The following sections give a brief overview of the last ten years of automobile safety regulation and of what effect it has had on automotive technology. The overview is by no means a complete history of automobile safety regulation. Although the NHTSA is a relatively small
agency and has duties other than safety regulation, in ten years it has been able to process a great deal of rulemaking. Not all of the detail of that rulemaking can be reviewed here. In particular rulemaking concerned with trucks, buses, and motorcycles is not mentioned.

3.1 Standards Issued

There have been thirty-six safety standards issued which affect new automobiles. In addition, there have been amendments to these standards, some of which have changed the requirements of the original standards to such an extent that they should be discussed as though they were separate standards. It is convenient, and not misleading, to categorize the standards and amendments into three historical groups.

3.1.1 Initial Standards and Immediate Additions

The drafters of the 1966 Safety Act had in mind particular existing standards that would serve as the basis for the initial federal motor vehicle safety standards. It was anticipated that the current General Services Administration (GSA) standards for government-purchased vehicles, existing federal standards for brake fluids and seat belts, existing state standards for the installation of seat belts, and voluntary industry standards, particularly those of the Society of Automotive Engineers (SAE), would be used as sources for the new standards.

The twenty-four standards listed and described in Table 3.1 are those that were derived from these sources. Twenty of these were issued.
together in January 1967, just four months after passage of the Safety Act; the remaining four, and an amendment to MVSS 108 extending it to automobiles; were delayed and issued somewhat later.

The first twenty standards followed closely the requirements of the GSA and SAE standards. The GSA standards themselves either were based on SAE standards or were specifications for features that were already optional on most models. The domestic manufacturers had announced in 1965 that they would incorporate most of the GSA requirements as standard features in 1966 and 1967 models. Thus, the first twenty standards, effective with the 1968 models, did not contain any significant new requirements. Many simply codified existing features.

Of the four other standards in this category, MVSS 109 and MVSS 110 adopted an existing voluntary standard of the Rubber Manufacturers Association. The impact of these two standards was felt by the tire manufacturers rather than by the automobile manufacturers. MVSS 116 was a recodification of the existing mandatory federal standard for brake fluids. The head restraint standard, MVSS 202, made mandatory a device which had previously been optional with some models, but it set new dimensional and strength requirements. Compliance with the standard required new designs and retooling by all manufacturers. The amendment to MVSS 108 required side marker lights and reflectors; the GSA standard from which it was derived had only required one or the other.

The standards in this category took some of the best practices of the domestic manufacturers, upgraded them in a few cases, and made them mandatory on all model lines and all manufacturers, including foreign
manufacturers. The fact that the twenty-four standards all had precedents in industry practice does not mean that they placed no burden on the manufacturers. Product redesign and retooling were needed to incorporate previous options on all product lines and to meet the few completely new requirements in the standards. Foreign manufacturers were affected by the standards more severely than the domestic manufacturers since most had not been involved in the voluntary incorporation of the GSA features and their home countries had not started any similar regulatory program. The twenty-four standards were also the first for which compliance was required by law. The industry had previously treated the SAE standards as design guidelines only; some of them were only meant to be specifications for equipment and parts bought by the vehicle manufacturers from smaller supply firms. The voluntary incorporation of the GSA features was also without enforcement. The Safety Act, however, required manufacturers to certify every vehicle as complying with the standards. Where previously a manufacturer might have some vehicles fall short because of production variations and design inaccuracies, now the manufacturer had to adjust design target upwards to compensate for such variations. In addition, certifying compliance of vehicles required formal testing, both destructive and nondestructive, and elaborate record keeping.  

These twenty-four standards are not typical of the overall federal regulatory effort. The technical basis for their content was for the most part already at hand. The devices and design techniques needed to allow compliance with their requirements had been accumulated over
### TABLE 3.1

**Initial Safety Standards and Immediate Additions**

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Date Issued</th>
<th>Date Effective</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>1-31-67</td>
<td>1-1-68</td>
<td>Control Location, Identification and Illumination</td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>do</td>
<td></td>
<td>Transmission Shift Lever Sequence, Starter Interlock, Transmission Braking Effect</td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>do</td>
<td></td>
<td>Windshield Defrosting and Defogging</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>do</td>
<td></td>
<td>Windshield Wiping and Washing Systems</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>do</td>
<td></td>
<td>Hydraulic Brake Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Requires split brake system and failure warning lights, sets stopping distances.</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>do</td>
<td></td>
<td>Brake Hoses</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>do</td>
<td></td>
<td>Reflecting Surfaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Requires dull finish on certain surfaces.</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>do</td>
<td></td>
<td>Lamps, Reflective Devices and Assoc. Equip. Requirements for trucks and buses.</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>do</td>
<td></td>
<td>Rearview Mirrors</td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>do</td>
<td></td>
<td>Occupant Protection In Interior Impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Requires padding in certain locations, sets performance criteria for it.</td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>do</td>
<td></td>
<td>Impact Protection for the Driver</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Requires collapsible steering control.</td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>do</td>
<td></td>
<td>Steering Control Rearward Displacement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Limits rearward displacement in frontal crash at 30 mph.</td>
<td></td>
</tr>
</tbody>
</table>

51
<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Date Issued</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>205</td>
<td>do</td>
<td>Glazing Material</td>
<td>Requires high penetration resistant windshield glass.</td>
</tr>
<tr>
<td>206</td>
<td>do</td>
<td>Door Locks and Door Retention Components</td>
<td>Static strength requirements for locks hinges, and safety latches.</td>
</tr>
<tr>
<td>207</td>
<td>do</td>
<td>Seating Systems</td>
<td>Static strength requirements on seat anchorages.</td>
</tr>
<tr>
<td>208</td>
<td>do</td>
<td>Occupant Crash Protection</td>
<td>Requires installation of lap and shoulder belts meeting Standard 209.</td>
</tr>
<tr>
<td>209</td>
<td>do</td>
<td>Seat Belt Assemblies</td>
<td>Static strength and other requirements.</td>
</tr>
<tr>
<td>210</td>
<td>do</td>
<td>Seat Belt Assembly Anchorages</td>
<td>Location and static strength for seat belt attachment points.</td>
</tr>
<tr>
<td>211</td>
<td>do</td>
<td>Wheel Nuts, Wheel Discs, and Hub Caps</td>
<td>Bans spinner-type hub caps.</td>
</tr>
<tr>
<td>301</td>
<td>do</td>
<td>Fuel System Integrity</td>
<td>Limits leakage in frontal crash.</td>
</tr>
<tr>
<td>109</td>
<td>11-8-67</td>
<td>New Pneumatic Tires</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-1-68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>11-1-67</td>
<td>Tire Selection and Rims</td>
<td>Requires tires meeting Standard 109 as original equipment.</td>
</tr>
<tr>
<td></td>
<td>4-1-68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>2-12-68</td>
<td>Head Restraints</td>
<td>Requires installation and sets location and static strength criteria.</td>
</tr>
<tr>
<td></td>
<td>1-1-69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Number</td>
<td>Date Issued/Date Effective</td>
<td>Title</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------</td>
<td>--------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Amend 108</td>
<td>12-16-67/1-1-69*</td>
<td>Lamps, Reflective Devices, and Assoc. Equip.</td>
<td>Extended to include automobiles. Requires side marker lamps and reflectors and hazard warning flashers, plus usual lighting and signal lamps</td>
</tr>
</tbody>
</table>

* Date of effect for most requirements. Manufacturers were given a choice between side marker reflectors and side marker lamps until 1-1-70.
decades of industry research and product improvement. The disruption to
normal industry practice was of only slight to moderate significance. The political momentum of the recent passage of the Safety Act helped
carry the NHTSA past obstacles to rulemaking that later became more
troublesome. The only serious difficulties encountered were with MVSS
201, on interior padding. There the NHTSA attempted to combine very
stringent requirement with vague performance terminology, and to defend
the attempt in the only formal rulemaking proceeding it has ever begun.
The attempt ended with the retraction of the contested proposals.

3.1.2 Minor Subsequent Standards

Table 3.2 describes eight standards that are subsequent in the sense
that the GSA and SAE standards were not the sources for their concepts
and requirements. They therefore represent a different, later phase of
the regulatory effort. The standards have been denoted minor here
because each regulates only an optional accessory, affects only localized
parts of an automobile, or could be complied with using technology that
was well known and in scattered use at the time it was issued.

MVSS 112 on headlamp concealment devices, MVSS 113 on hood latch
systems, and MVSS 124 on accelerator control systems were issued to
correct specific safety hazards that were newly coming to the attention
of the NHTSA. MVSS 118 on power windows and MVSS 302 on fabric flam-
mability were issued to deal with problems that had been recognized for
some time. MVSS 212 on windshield mounting eliminated designs on some
foreign models which had allowed the windshield to pop out of its moun-

54
<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Date Issued</th>
<th>Date Effective</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>112</td>
<td>4-24-68</td>
<td>1-1-69</td>
<td>Headlamp Concealment Devices</td>
<td>Requires fail-safe operation of headlamp concealment devices.</td>
</tr>
<tr>
<td>113</td>
<td>4-24-68</td>
<td>1-1-69</td>
<td>Hood Latch Systems</td>
<td>Requires two-position latch system or two independent latch systems.</td>
</tr>
<tr>
<td>114</td>
<td>4-24-68</td>
<td>1-1-70</td>
<td>Theft Protection</td>
<td>Steering wheel lock, reminder buzzer.</td>
</tr>
<tr>
<td>115</td>
<td>7-3-68</td>
<td>1-1-69</td>
<td>Vehicle Identification Number</td>
<td>Requires VIN to be visible on dashboard.</td>
</tr>
<tr>
<td>212</td>
<td>8-13-68</td>
<td>1-1-70</td>
<td>Windshield Mounting</td>
<td>Requires retention of windshield in 30 mph frontal crash.</td>
</tr>
<tr>
<td>118</td>
<td>7-17-70</td>
<td>2-1-71</td>
<td>Power-Operated Window Systems</td>
<td>Prevents side windows from operating when ignition key is not present.</td>
</tr>
<tr>
<td>302</td>
<td>12-31-70</td>
<td>9-1-72</td>
<td>Flammability of Interior Materials</td>
<td>Sets flammability criteria for interior fabric and trim.</td>
</tr>
<tr>
<td>124</td>
<td>3-31-72</td>
<td>9-1-73</td>
<td>Accelerator Control Systems</td>
<td>Requires fail-safe design for automatic speed control devices.</td>
</tr>
<tr>
<td>Amend. 208 &amp; 209</td>
<td>various</td>
<td>various</td>
<td>Seat Belts</td>
<td>Standardized buckles, required one-piece design for lap and shoulder combi-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>nation, added convenience features.</td>
</tr>
</tbody>
</table>
ting on impact before it could serve to help absorb the kinetic energy of unrestrained occupants or retain them inside the vehicle; most domestic models met the requirements of the standard before it was issued. MVSS 114 and 115 were developed by the NHTSA in conjunction with the Department of Justice. The features required by MVSS 114 were found at the time only on some domestic and German models and had to be newly integrated into the steering and ignition systems of other models. The set of amendments to MVSSs 208 and 209 which affected seat belt design were issued over a period of several years. Some were part of rulemaking directed specifically at seat belts while others were part of passive restraint rulemaking. The effect of the amendments was to standardize seat belt design so as to reduce user problems caused by unfamiliarity and to make certain convenience features mandatory in an effort to increase seat belt usage.

Some minor amendments to other standards could also be included in this category. They and the standards that are listed here were the outcome of unremarkable rulemaking, the process of which does not merit special comment here.

3.1.3 Major Subsequent Standards

The four standards and three major amendments listed in Table 3.3 deserve the designation major for several reasons. Some set performance requirements that are not restricted in scope to localized parts of the car or to individual pieces of equipment, in contrast to standards in the last category. Some have been major cost items; and some attempt to
deal with important safety problems. Together they and their histories are the most interesting of all the standards that deal with automobiles. The discussion of the standards here will be briefer than they deserve.

MVSS 214 requires a static crush performance test for side doors, intended to increase protection in side impact collisions. The standard has had the effect of making mandatory a combination of door beams and reinforced pillars that was developed and first introduced by General Motors on its own initiative. The process of rulemaking on this standard took slightly less than eleven months to complete, from first NPRM to final rejection of petitions for reconsideration.

The exterior protection standard, MVSS 215 is actually a bumper standard. The standard has caused substantial, and relatively expensive, changes in bumper design. It standardized the height of bumpers and led to the energy-absorbing designs that are now common. The standard added about $136 to car prices in model year 1974, the year its requirements first affected both front and rear bumpers. Rulemaking on the standard was in progress from 1970 to 1975.

MVSS 219 was developed in three rulemaking steps from mid 1972 to mid 1975. The standard sets performance requirements which prohibit the engine lid and other parts of a car from penetrating through its windshield in a frontal crash at 30 mph. Compliance with the standard required reinforcement of existing engine lids and attaching hardware on those models which did not already comply.
The hydraulic brake amendment to MVSS 105 introduced more stringent stopping distance requirements to replace the old SAE-based ones and added new requirements for brake pedal forces, brake fade, and wet brake recovery. Rulemaking for the standard began in 1970 and continued into 1976; the many details of the amendment were worked out in a complex series of petitions and responses over this period.

The fuel system integrity amendments to MVSS 301 were five years in the making; the final version was settled in March 1974. The amendments added side, rear, and rollover tests to the initial MVSS 301 which had only contained a requirement for frontal crashes. The new requirements became fully effective with the 1977 model year.

The passive restraint amendment to MVSS 208 is now in its second life. The amendment began as a proposal in 1970 and was rushed through an extraordinarily complex sequence of petitions, proposals, and revisions until — and even after — it was published in its final form in early 1972. The amendment in that form was remanded to the NHTSA by a court of appeals in late 1972 for correction of deficiencies in the specifications for the test dummy that was to have been used in compliance testing. Between then and 1976 the only related agency rulemaking actions were the issuance of the revised dummy specifications and the reproposal of passive restraint requirements that were never made final. In 1976 then-Secretary of Transportation William Coleman took control of the rulemaking from the Administrator of the NHTSA. The Secretary decided against issuing a passive restraint requirement at the time, but managed to arrange agreements with several manufacturers for
<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Date Issued</th>
<th>Date Effective</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>214</td>
<td>10-22-70</td>
<td>1-1-73</td>
<td>Side Door Strength</td>
<td>Static crush strength criteria for doors.</td>
</tr>
<tr>
<td>215</td>
<td>4-9-71*</td>
<td>9-1-76**</td>
<td>Exterior Protection Standard</td>
<td>Standardizes heights of bumpers, sets damage criteria for 5 and 2.5 mph impacts.</td>
</tr>
<tr>
<td>216</td>
<td>12-3-71</td>
<td>8-15-73</td>
<td>Roof Crush Resistance</td>
<td>Static crush strength criteria for portion of roof near windshield.</td>
</tr>
<tr>
<td>219</td>
<td>6-9-75</td>
<td>9-1-76</td>
<td>Windshield Zone Intrusion</td>
<td>Sets criteria for intrusion of hood and other parts into zone needed to allow for safe deformation of windshield struck by occupant.</td>
</tr>
<tr>
<td>Amend. 301</td>
<td>8-20-73</td>
<td>9-1-75</td>
<td>Fuel System Integrity</td>
<td>Adds static roll-over test after front crash test.</td>
</tr>
<tr>
<td>Amend. 301</td>
<td>3-21-74</td>
<td>9-1-76</td>
<td>Fuel System Integrity</td>
<td>Adds front angular, rear, and side crash tests, each with roll-over.</td>
</tr>
<tr>
<td>Amend. 208</td>
<td>various</td>
<td>various</td>
<td>Occupant Crash Protection</td>
<td>Converts the seat belt installation standard to a passive restraint standard.</td>
</tr>
</tbody>
</table>

* Date given is that of issuance of the first version of standard or amendment. Modifications continued after this date.
** Date given is that of the effective date for full requirements of standard or amendment. Requirements took effect in steps.
a voluntary large-scale demonstration program of passive restraints before he left office in January 1977. His successor, Brock Adams, abrogated these agreements and has recently issued the passive restraint amendment in its second final form. It now is less stringent in several ways than the earlier form. If the amendment survives review by Congress and a possible but improbable court review, passive restraints will be introduced during model years 1982 through 1984, starting with large cars and ending with small cars.

MVSS 216 was issued during the development of the first passive restraint amendment as an interim measure to improve the roll-over crash integrity of roof structures until provisions in the planned passive restraint amendment on the same subject took effect. The standard has been in effect since then and will no doubt remain, as the present passive restraint rule does not require rollover tests. When it was issued the standard necessitated minor reinforcement of the windshield header and front roof pillars in cars that did not already meet its static crush strength requirements.

3.2 Standards Not Issued

There have been a great many areas of automobile safety in which the NHTSA has begun rulemaking or research but in which it has not yet issued any safety standards or upgraded existing standards. In some of these areas, notices of proposed rulemaking were published and then withdrawn or left pending indefinitely. In other areas, extensive research pro-
jects have been conducted and described as intended to support eventual rulemaking. These proposals and research projects have been as much a part of the last ten years of regulation as have the standards that were actually issued. Some of them are briefly described here.

**Lighting and Signaling**

In 1970 the NHTSA began rulemaking on a major revision of MVSS 108, relying in part on the findings and recommendations of its research contractors and on comments to an ANPRM it had issued just previously. The NPRM for revision was published in October 1972. It proposed major changes in front lighting and less radical but still significant changes in rear signaling.

In the area of rear signaling the notice proposed a requirement that brake lamps be physically separated from other rear lamps and spaced apart from them by at least a specified distance. The relative positions of tail, brake, and turn signal lamps were to be restricted to only a few arrangements. This was a change from the existing provisions or MVSS 108, which allowed all three signal lamps to be combined behind a single lens. The agency proposed to replace the traditional two-beam headlighting systems with three-beam systems which its research contractors recommended as better compromises between increased illumination and increased glare.

The NHTSA withdrew the NPRM in April 1974, after encountering technical criticism and resistance from manufacturers. Since then the agency has conducted more research in both front lighting and rear signaling.
The NHTSA obviously continued development on a new version of at least the rear signal portion of the withdrawn NPRM, but by the 1975 annual report it was no longer listing this as an area of activity.

Visibility

In January 1971 the NHTSA published an NPRM for new indirect visibility requirements, to be incorporated into MVSS 111 by amendment. The agency explained the rationale for the new requirements in terms of the field of view requirements needed in lane changing and other maneuvers. The requirements of the proposed amendment were to take effect in two steps. The first step could have been satisfied with upgraded rearview mirror systems. The second step seemed to leave through-the-roof periscope devices as the only obvious means of compliance. The proposal, especially the second step requirements, was severely criticized by automobile manufacturers.

A companion NPRM was published in April 1972 dealing with direct fields of view. The proposal was stringent enough that it would have forced redesign of the bodies of many car models. Some of its provisions could be interpreted to be design restrictions rather than performance requirements. This proposal was also met with resistance from manufacturers.

The NHTSA withdrew both visibility NPRMs in 1973 and announced that new proposals would come before any standards were issued. The reason it gave was that it was undertaking further research programs in both areas. It did, but no new proposals have followed from the research.
High Speed Limitation

In December 1970 a proposal was published for a new safety standard on speed limitation. The proposal set a maximum attainable speed of 95 mph, required automatic activation of warning flashers and horns above 81 mph, and restricted the labeling of speedometers so that they would not indicate any speed higher than 85 mph. Reaction from individual citizens was predominately adverse to the proposal. Three years later the agency remarked in a request for comments that the practicability of the first two requirements had not been established but that it was still interested in the third. Another two years later, in August 1976, it published a new NPRM containing the third requirement and some new proposals on odometers. This notice was withdrawn but quickly republished and is now pending.

Pedestrian Protection

The NHTSA has conducted broad research on pedestrian safety, including the role of automobiles in pedestrian injury causation and mitigation, since 1967. In October of that year it issued an ANPRM that vaguely contemplated regulation of all external protrusions and contours on automobiles. In December of the same year it proposed a new standard that would have regulated hood-type ornamental protrusions only by setting maximum breakaway loads for them. This proposal was not followed by a rule. In its 1971 Program Plan the agency expressed an intention to regulate protection in performance terms, possibly by using a test dummy as it was then planning to use for passive restraint performance tests. Since 1971 the agency has continued to work on the develop-
ment of a standard of this type, apparently without much success.

Other Areas

There are other areas of automobile safety that are sometimes mentioned in critiques of the existing set of standards. The NHTSA has proposed dynamic testing of seat belts using test dummies in the same way that passive restraints will be tested, but has never made final a requirement. It has recognized that adjustable head restraints, allowed under the initial version of MVSS 202, were not being adjusted properly in many cases and as a result were not giving the expected protection from whiplash injuries; although some models have integrated seat backs and head restraints that do not require adjustment, the NHTSA has made no move to require this for all models. There are several performance tests that now use static forces that could be converted to dynamic performance tests using more realistic barrier crashes. The fabric flammability requirements of MVSS 302 have been claimed to be inadequate. There are several important standards for automobiles which do not apply to other vehicles frequently used for personal transportation; this lack of coverage also has been criticized.

3.3 Appraisal

The safety technology that is now used in automobiles is remarkably similar to what it was in 1968, the first year that federal safety regulations were in effect. The standards applicable that year, and four standards applicable slightly later, had in effect been imposed by
Congress itself rather than by the NHTSA. 1968 should be the base year for judging the accomplishments of the continuing program of regulation. Bumpers, brakes, and fuel systems are now designed to meet requirements very different from those in 1968. Side doors are also, but that was a change introduced by General Motors and only made universal by regulation. Passive restraints, when and if the recent amendment takes effect, with be the first example of a completely new device being forced into use by regulation, unless one counts the ignition interlock as having been in this category.

The regulatory regime has been fairly successful in getting changes made in localized parts of the vehicle, and in correcting many seemingly minor or unusual safety problems. A distinguishing feature of changes in this category — accelerator control systems, hood latches, power windows, steering column locks, etc. — is that they were easily integrated into the surrounding, unchanged vehicle. Changes that would have affected large portions of the vehicle, as would have the direct visibility proposal for example, have not occurred. Nor have changes that would have radically altered the appearance of automobiles, for example the periscope implied by the indirect visibility proposal. The bumper and fuel system standards are located somewhere between these two extremes of easily integrated and broadly disruptive changes. They were accomplished only after extended rulemaking proceedings.

The effect of safety standards on the cost of an automobile has been noticeable, but not large. The most recent available estimates of the cumulative costs are in the range of $320 per automobile, an amount
often spent on accessories alone.* This does not include the effects of the fuel system integrity amendments, but these are expected to be small.19 The adoption of air bags to meet the passive restraint requirements will cause this figure to double by some estimates, to increase by a third by other estimates.20 The safety impact of the standards taken together has also been significant. The General Accounting Office has estimated that the chances of surviving an accident have been increased by about 25 percent over that for pre-1966 models, but due mostly just to the initial standards.21 The reduction in the chances of having an accident are unknown because of measurement difficulties, but is presumably positive as well:

The process of regulation has not been smooth or cordial, especially for the major subsequent standards. The extended passive restraint rulemaking has been the most bitter. There have been long unexplained delays in some rulemaking cases, and prolonged indecision in some others. Regulatory activities have not been confined to the NHTSA. The Secretary of Transportation, the White House, the Congress, and the courts have all become involved.

The degree of federal control over automobile design achieved during a decade of safety regulation and the exercise of that control may have exceeded what the automobile manufacturers expected when they conceded

---

* In the model year (1974) used in the estimate of the cost of safety standards, air conditioning as an option cost from $400 to $450 and was included in 68% of new cars sold.15 Vinyl tops were from $100 to $150 and were included on 47% of sales.
defeat in 1966 and reluctantly supported the establishment of the regulatory regime. They have certainly not been resigned to each exercise of federal control over the last ten years. Safety advocates, on their part, have been disappointed with the results and non-results of regulation, as they have repeatedly made clear. In its last program plan, issued in 1971, the NHTSA described its intentions for new and revised safety standards. The agency's accomplishments in the intervening years seem limited compared to its own ambitious goals as expressed in that program plan. The difficulties encountered in the process of regulation have been greater than anyone expected in 1966.

The process and substance of automobile safety regulation should not be judged only in comparison to expectations that were held by one or another of the participants in the creation of the regulatory regime. To do so would be uncharitable to the individuals who have operated the regulatory regime in the face of problems that were not anticipated by those who helped to create it. It would be overly considerate of some of the latter individuals, whose expectations and intentions at the time were poorly formulated and less than rational. And most importantly, it would provide little insight into important practical problems that automobile safety regulation shares with other regulatory efforts.

The following chapters examine the process and results of the last decade of regulation on their own merits. Chapter 4 reconsiders the stated goals of regulation and the disparities and correspondences between them and what economic theory suggests in their stead. Chapter 4 also takes a careful look at technological change, which automobile
safety regulation seeks to achieve. Chapters 5 and 6 consider what has happened as the NHTSA, the agency to which has been assigned the task of achieving the goals of the regulatory regime, has gone about trying to do so. In contrast to the present chapter, Chapters 5 and 6 deal more with the process of regulation and the problems inherent in it than with its outcome as such. In doing so, however, it becomes possible to better compare what has been accomplished with what might have been.
REFERENCES TO CHAPTER THREE

1. Federal motor vehicle safety standards are codified at 49 C.F.R. 571.

2. The original GSA standards can be found at 30 F.R. 8319, June 30, 1965; amendments were published at 31 F.R. 9628-9638, July 15, 1966.

3. See MacDonald, Harold C., "Engineering to Meet Federal Vehicle Safety Standards," SAE 680193, for a description of what was required for one manufacturer (Ford) to comply with the initial standards.


6. The most complete published estimates of the cost impacts of individual standards were provided by the manufacturers to a Senate oversight committee in 1974. See their testimony in Motor Vehicle Safety Oversight Hearings, Committee on Commerce, United States Senate, 93rd. Cong., 2d. Sess., 1974.


8. For histories of the passive restraint amendment see:

"History of the Air Bag and Modified Standard 208: The Long (and Unfinished) Road to Universal Passive Protection of America's Motorists," Center for Auto Safety, 1974;

Federal Regulation and Regulatory Reform, Report by the Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, 94th Cong., 2d. Sess., October 1976, Chapter 5;

and references 9 and 11 below.

REFERENCES TO CHAPTER THREE
Continued


11. 42 F.R. 34297.


CHAPTER FOUR

RE-EXAMINATION OF THE OBJECTIVES OF REGULATION

The Safety Act established the institutions and the mechanism by which centrally made decisions could replace decisions previously made by automobile manufacturers and buyers. Congress was not so clear on what was to be done with the new mechanism, however. The struggle in 1966 was over whether the Secretary of Transportation would be allowed to set mandatory standards or whether reliance would be placed on voluntarism, and over whether once given authority the Secretary would be required to use it or would be given complete discretion. Attention was focused on the near-term possibilities of the GSA and SAE standards. Objectives that could be used to guide regulation for years afterwards were not very well formulated. Obviously, it is impossible to judge how well regulation has performed without an understanding of what it was supposed to do and what it should have been supposed to do. The following sections discuss these questions.

4.1 Programmed Objectives vs. Ad Hoc Decisionmaking

There is evidence which might suggest the existence of a predetermined or programmed goal for automobile safety regulation, some level of safety it was supposed to achieve. It has often been said that the goal

71
of automobile safety regulation is to stop the "carnage on the highways". The preamble to the Safety Act clearly states the law's purpose to be the reduction of traffic accidents, deaths, and injuries. Congress declared a "need for motor vehicle safety" which standards are supposed to meet. Standards must be stated in performance terms, which suggests that it is some level of safety performance that is the object of issuing standards. The "appropriateness" clause was explained by the Senate Commerce Committee to mean that different types of automobiles would not necessarily have to meet the same requirements, "so long as all motor vehicles met basic minimum standards." The statements of the NHTSA since passage of the Act are similar. The NHTSA has always viewed the reduction of traffic deaths and injuries as its official mission, to be accomplished through both its vehicle and highway safety programs. Early in its life, it set a goal for itself of a one-third reduction in the traffic death rate. A more recent NHTSA working order on program planning states the agency's preference for planning goals expressed directly in terms of reductions in fatalities and injuries. The magnitude of highway losses, which could be called a carnage on the national scale, is referred as unacceptable in reports by the NHTSA and in statements of witnesses before congressional committees. The NHTSA sometimes speaks of the necessity of reducing traffic fatalities to a "bearable level". From evidence like this it would be reasonable to conclude that either a reduction in highway losses to a zero level or perhaps to a specific "bearable" or "reasonable" level is the programmed goal of the regulatory regime.
It is clear that in 1966 the supporters of the Safety Act were unsatisfied with the types of automobiles that were being produced and wanted safer cars that would reduce traffic losses. In 1966 there were many types of automobiles that the manufacturers could have been producing, only a relatively few of which were in actual production. Some of those that were in production were safer than others. And some that were not in production but could have been would also have been safer. Thus, movement towards more safety was possible. The same has been true since. But changes in vehicle design that increase safety can also be expected to increase cost. Some changes in design can be made with no additional manufacturing cost if timed to coincide with normal redesign and retooling. Even these types of changes might require reductions in the attractiveness and convenience of automobiles, which are equivalent to an increase in cost from the point of view of a car buyer and user. The supply of such costless changes would eventually be depleted, and reliance would have to be placed on changes that require more steel, padding, etc. Greater safety would then come only with increasingly greater cost. If an unbounded movement towards safer cars is begun, eventually the wisdom of indefinitely greater safety as a goal of regulation collapses into absurdity. Clearly no one in Congress would have insisted that traffic deaths were going to be eliminated entirely.

To claim that there is a specific level of safety that is the goal of regulation avoids the absurdity, but still begs the question since no specific level has ever been claimed to be the goal. The NHTSA's one-third reduction was to be only the start of the effort; the agency never
suggested that that reduction would be sufficient. It could be said that regulation is intended to increase safety only to the point at which the public is protected from unreasonable risks. But reason is an individual faculty and consensus on a collective definition of unreasonable risk has not been achieved. The stated goals of regulation seem nothing more than poorly formulated symbolism disguising the true ill-defined \textit{ad hoc} nature of the regulatory regime.

An \textit{ad hoc} approach, one in which decisions are made on individual standards rather than on an overall goal for the regulatory program, is not necessarily ill-defined, however. An \textit{ad hoc} approach is workable if a criterion of desirability exists and can be used to the judge the desirability of possible movements towards greater safety. The objective of regulation would then be to take advantage of desirable changes in safety by issuing standards that would force those changes into practice. The criterion, of course, should respond to both the attractive and unattractive consequences of each proposed standard. There would still be a question as to whether any desirable changes are possible, i.e., whether there are any opportunities of which regulation can take advantage.

The drawback of an \textit{ad hoc} approach is that it can overlook changes that could have been considered more desirable than any of those that are considered at one time. An \textit{ad hoc} approach does not necessarily mean that decisions are made on one proposal at a time, however. A set of proposals may be considered together. The approach does mean that decisions are made on alternatives for action rather than on a final goal.
There is a point of view that fits in well with such an ad hoc interpretation of regulation. This is that the safety of automobiles is a matter that affects the public interest, that the political process — subject to constitutional constraints — is the legitimate resolver of matters affecting the public interest, and that the Safety Act did not so much define the public interest as indicate the direction in which it lay and establish the mechanism and institutions through which the political process would decide the desirability of particular standards as they were proposed. Under one variant of this view, the Administrator of the NHTSA is the legitimate finder of the public interest in matters of automobile safety. In another variant, Congress merely gave to the NHTSA the task of doing the technical and procedural details of regulation, requested it to work towards indefinitely greater safety, and then stood ready to overrule individual standards which it, Congress, decided were not desirable, or not in the public interest. Congress would be able to do so because of its direct ties back to the electorate. The essence of this perspective is that the substance of regulation is desirable if the process of regulation follows legitimate procedures.

This political perspective is difficult to refute on its own terms. It coincides with modern liberal democratic thought and with observed history in that Congress has in fact overruled some decisions by the NHTSA. But the perspective is not entirely satisfactory. First, it seems right that there should be measures of social desirability definable apart from what Congress desires. Certainly political processes have in the past produced some disastrous outcomes without losing their
legitimacy. Second, agency officials and even congressmen are not so constantly attuned to the will of the people as to not need some other, more objective, guidance in their decisionmaking.

Welfare economics, while it goes very little of the way towards resolving the problem of a desirability criterion, does provide the concepts needed to discuss the problem in precise terms. The next section provides such a discussion and re-examines the provisions of the Safety Act in light of that discussion.

4.2 The Economics of Social Desirability

There are many possible automobile types that automobile manufacturers could produce. Each is characterized by a combination of many attributes: manufacturing cost and selling price, operating cost, style and comfort, acceleration performance, and, of special interest, the risks of death and of injuries of different type and severity that it presents when in use to its driver, other occupants, and persons like pedestrians and occupants of other vehicles who will be near it. This risk could be further broken down into risks from side collisions, frontal collisions, etc., or risks of death from fire, from crushing, from lacerations, etc. The collection of all such combinations of attributes which could be realized in an automobile is the production space. At any one time there are many points in the production space represented by cars that are actually in production, but many that are not. At the least, all past models should be capable of production and therefore in
the production space. Other points in the space correspond to modifications of existing models, for example the addition of more padding or the redesign of structural members, or to completely new models. In economic terms, the recurring question facing a regulatory regime that uses ad hoc decisionmaking is that of the desirability of moving from one set of points in the production space, that representing current car models, to another set, that representing the car models which manufacturers would produce and sell to comply with a new standard.

Welfare economics traces desirability back to the preferences and wellbeing of individuals and then tries to reach conclusions about social welfare or social desirability on the basis of those individual preferences. Using this scheme it becomes necessary to examine what effect a new safety standard has on individuals. A safety standard changes the selection of automobiles that car buyers can and will choose from, usually raising their price. The manufacturers' profits will be reduced and with them the value of the equity held by their stockholders. The new car buyers, the occupants of the new cars, occupants of other vehicles, or pedestrians will receive a reduction in the risks of personal injury or death, depending on the nature of the safety improvement.

* It is imperative to maintain an ex ante view of a safety standard as reducing risks of death and injuries rather than an ex post view of it as reducing actual deaths and injuries. True, in a nation of 220 million people and 100 million vehicles, changes in individuals' risks give nearly predictable changes in actual deaths and injuries. If fact, observing or predicting changes in actual deaths and injuries may be the easiest way to calculate the changes in individuals' risks. But no individual dies or lives because of a motor vehicle safety standard and its effect on vehicle performance. The modern view of traffic safety is that accidents are random events whose probability is only conditioned by vehicle design and performance, driver performance, and environmental
Their friends and relatives receive a reduction in the risks of bereavement and loss of support. And a very wide group of persons receive reductions in the income drain of accident-caused claims on risk-spreading social insurance systems of all types. There are still other effects felt by persons with various relations to the buyers and users of the affected automobiles. Individuals, as a result of changes in their incomes, risks of death and injury, etc., may regard themselves as having been made better off or worse off, depending on the changes for each and on their own preferences.

Once each individual's change in wellbeing is established, the question of social desirability is reduced to a question of how changes in individuals' wellbeing relate to changes in social wellbeing, i.e., what sets of changes in individuals' wellbeing are to be considered desirable. Welfare economics has only one objectively valid normative statement to make: if every individual considers himself to have not been made worse off and at least one considers himself better off, the overall conditions including other drivers and vehicles. Adopting an ex post view makes a rigorous economic analysis impossible. Welfare economics depends on changes in individual wellbeing caused by changes in the allocation of resources and the distribution of goods. If some individuals cease to exist during a change, it becomes absurd to claim to speak objectively of a change in their individual wellbeing. They certainly are not available for comment. Injuries are also best treated ex ante, as this avoids hypothetical questions about what would be necessary to compensate a person for a seriously disabling injury, like dismemberment or paralysis. In contrast, it is proper to take an ex post view of the income reduction felt by persons whose only relation to the killed or injured is through social insurance systems, since, because of the large numbers involved, a safety standard gives a nearly certain change in claims on social insurance systems and these persons remain in existence before and after the change caused by the standard and feel only the income effect.
change should be considered desirable. It is the change, not the final state, that is desirable. Another desirable change may still be possible. If none is, the final state is defined to be "pareto-optimal" or "efficient".

This contribution from rigorous welfare economics is weak, but it is the best that can be offered. By itself this pareto principle of desirability does not even imply that risks of death from laceration should be reduced before risks to the same persons of death from fire when the former is cheaper, since individuals may distinguish in their preferences between equal risks of the two ways of dying. It does imply that safety standards should at least be cost-effective, i.e., that a given amount and type of risk-reduction should be achieved at minimum penalty in cost, or convenience, etc.

The weakness of the criterion is that given any nonpareto-optimal starting state the desirability criterion applies only to some of the changes from that state, those that do not make any person worse off or do not make any person better off. But changes between pareto-optimal states, from pareto-optimal states to nonpareto-optimal states, and between many pairs of nonpareto-optimal states leave some persons better off and others worse off. These changes cannot be judged desirable or undesirable. The pareto principle does suggest that it is undesirable to choose a nonpareto-optimal final state, since from such a state a desirable change is possible.

There is an equivalence theorem of welfare economics which shows that market systems satisfying three conditions will at least achieve one of
the pareto-optimal states, though which one of the many that are possible depends on the initial distribution of productive assets. One obvious way to augment the pareto principle into a workable desirability criterion would be to set as the goal of safety regulation the state that would result from a perfect market given the current distribution of assets. This type of implicit goal is common in the frequent support from economists for emissions taxes, consumer information programs, antitrust actions, etc. It is also true that market forces are effectively allowed to define desirability in most areas of economic activity. It will not serve as a goal for regulation, however. While it is easy to show that the target state is not being achieved without regulation, it cannot be reached with regulation, either.

The first point follows from the observation that the market for new cars, as modified by the accident liability and insurance systems, is failed, that is, it does not meet the three conditions of the equivalence theorem mentioned above. The argument that this is so was given by several economists in the period surrounding the establishment of the regulatory regime. It will not be repeated here. Briefly, none of the three conditions is met. The automobile industry is not competitive; it is a tight oligopoly. Consumers do not have very good information about what risks are posed by the automobiles they buy. And there are negative externalities in the consumption of unsafe automobiles that are not internalized by insurance and liability systems. The failure to satisfy the three conditions, and the direction of the failure of the last two, means that the unregulated market produces a nonefficient
result characterized by too little safety in the cars being produced and bought.

The second point follows from the observation that product regulation of the sort allowed by the Safety Act is too blunt an instrument to correct a failed market. If incomes and preferences of car buyers were identical, regulation could achieve the production of the same type of automobile that would be produced under a perfect market. But in the process, by artificially internalizing externalities, regulation would create income transfers from new car buyers to other individuals who would be put at less risk with safer cars but who would not have helped pay for their higher cost. As a result, regulation cannot achieve the exact pareto-optimal state that would result from a perfect market. Regulation is such a blunt and undiscriminating tool that when incomes and preferences are different among individuals, as they are, there will always be individuals who place a low value on risk-reductions for themselves and would willingly compensate the other persons put at greater risk if they were allowed to buy less safe but cheaper cars. Regulation cannot achieve any pareto-optimal state.7

There is another very common way to augment the pareto principle into a workable desirability criterion. This is to accept as desirable any change in which the individuals who are made better off are made so much better off that together they would be able to compensate the individuals who are made worse off and still come out ahead on the change. The hypothetical compensation, which does not actually occur, is through income transfers. This criterion is the foundation of cost-benefit
analysis, a decision rule that is widely used in evaluating government projects of many types, particularly public works projects. The transition to cost-benefit analysis is made by using preferences as revealed in market transactions to find the income transfer -- either the required compensation or the willingness-to-pay for benefits received -- that it would take to return each individual to a point of indifference as to the outcome of the change. The sum of these transfers, each with its appropriate sign, is used to judge desirability.

Ex ante cost-benefit analysis of automobile safety decisions is subject to two specific criticisms: it neglects distributional or equity issues and it treats reductions in the risk of death and injury as though they were no different than, say, the power produced by a hydroelectric project. The first criticism is true. Cost-benefit analysis could label as desirable decisions that produce very skewed increments in the distribution of income, unless the skewness of the distribution affects in the proper way individuals' own attitudes about the desirability of the decision for themselves. Further, cost-benefit analysis tends to reinforce the existing uneveness in the distribution of income, since willingness-to-pay depends on income as well as on preferences. The second criticism is not true. Cost-benefit analysis assumes that individuals themselves are willing and able to treat reductions in the risk of death or injury in the same way they treat the electricity they buy from a power project. If the assumption is true, it is hard to criticize ex ante cost-benefit analysis for respecting the preferences of the individuals. There is reason to suspect that serious problems with the assump-
tion will appear when it comes time to actually do an analysis; but people do freely buy certain risk-reductions in markets, for example in the purchase of home fire alarms.  

Congress did not intend to require that the NHTSA perform a cost-benefit analysis and obtain a favorable result before issuing each safety standard. As mentioned in Section 2.2.1 in the explanation of the "practicability" requirement, the House Commerce Committee explicitly did not include an equivalent requirement when it was suggested by the manufacturers. Individual congressmen, including subcommittee and committee chairmen, have repeatedly stated their opposition to attempts by other Executive Branch agencies to impose a cost-benefit requirement on the NHTSA's decisions. But the language of the Safety Act is general enough so as to not preclude a NHTSA Administrator from using a cost-benefit criterion in his own decisions about the "reasonableness of cost, feasibility, and adequate leadtime." Similarly, a unreasonable risk could be defined as one that could be corrected with a net gain in the difference between benefits and costs to all affected persons. The NHTSA is prohibited from issuing a safety standard that does not affect safety, for example if it believed that lifetime costs could be reduced if manufacturers installed higher grade parts that were not related to safety as original equipment. The NHTSA does not appear to be precluded from relaxing its own safety constraints on the grounds that the accompanying cost-reduction made a higher level of risk reasonable (with the probable exception of the fuel system integrity standard which Congress froze into law in 1974).
If an explicit criterion of social desirability is to be defined from individuals' preferences it must make use of some way to measure and compare the strength and define the importance of those preferences. Cost-benefit analysis is the least contrived way of doing this.

4.3 New and Known Technologies and the Process of Technological Change

The previous section relied on the concept of a production space, consisting of combinations of attributes which could be realized in an automobile, in its interpretation of regulation as a process of choosing desirable changes in the types of automobiles produced and sold. The section avoided attempting a more precise definition of the production space concept. Such a definition must be given, however, because the concept of the production space is closely related to the distinctions between known and new technologies and to the concepts of innovation and technological change. A clear understanding of two types of technological change is necessary to understand the interpretation of the objectives of automobile safety regulation that will be used in the following chapters.

There is a large literature on innovation and technological change in general, and a sizable one on technological change in the automobile industry in particular. Most of this literature relates to innovation in an unregulated market or in markets characterized by forms of regulation different than product performance standards. No attempt will
be made to integrate the distinctions made here with this literature, though none of them are inconsistent with those made by others. The definitions made here will be self consistent and adequate for the present need.

An automotive "technology" as the term is used here is a method of manufacturing a combination of target attributes into an automobile, in the mass quantities normally associated with the modern automobile industry. Some of these attributes may correspond to the type of performance that could be mandated by a safety standard and others may be cost, style, comfort, etc. In its fullest and final embodiment a technology consists of the detailed designs for the automobile, the factories and other capital goods like machine tools needed for production, the relevant skills of the workforce, and the managerial organization and techniques capable of ensuring that these are combined with appropriate material inputs to produce the actual automobiles. If these four exist and are in use mass-producing automobiles for sale, the technology is part of the current practice of the art. At a minimum, the production space contains the combinations of attributes represented by the various automobile models in production at any one time.

But the production space contains other combinations of attributes as well, in the sense that it would be possible to mass-produce automobiles other than those now being produced, with other combinations of attributes. Definitional subtleties arise in putting a precise meaning on the word "possible". The definition that will be used here is that a combination of attributes is contained in the production space if there is a
known technology for achieving those attributes in an automobile. A technology can be known even if the vehicle designs, capital equipment, workforce skills, and managerial organization needed to actually begin production do not exist. It is only necessary that it be known with some certainty how to bring each of them into existence from scratch or through modifications to existing vehicle designs, machine tools, assembly lines, etc. The creation or modification of vehicle designs, the design or selection, acquisition, and arrangement of capital equipment, the training of workers in new skills, and the structuring of managerial control lines will be called technology embodiment — an awkward phrase but one that will avoid any confusion. The automobile manufacturers and their suppliers have a technology of technology embodiment that is often nearly as methodical in its own way as the assembly of a single car. They use it regularly when engineering new models and model changes. The collection of known technologies which it would be possible to embody and thus put into practice is the state of the art. At any one time market forces and regulation combine to cause only a limited subset of the known technologies to be embodied as part of the current practice of the art.

The ability to embody a suitable technology separates those combinations of automobile attributes that are achievable with known technology from those that cannot be achieved without the prior development or generation of new technology. The distinction between technology embodiment and technology generation is a crucial one. The essence of the distinction is in what is required to complete the process. Technology
embodiment requires engineering to arrive at final designs for the automobile itself and for the manufacturing process that will produce it. Technology generation or development requires discovery, invention, innovation, breakthroughs or new concepts to succeed; it may be complete long before there are any final designs in existence. Technology embodiment is characterized by relative certainty of success, technology generation by relative uncertainty. In the American automobile industry, technology embodiment generally goes on at the division level within a manufacturing corporation; generation of new technologies more often occurs in corporate level research centers.

Some examples should help to clarify the distinction. The development by General Motors of the side door beam concept was an example of technology generation. Once it was done, the designing and tooling for door beams for Fords, Toyotas, and Volkswagens were examples of technology embodiment. The revision of MVSS 105, on hydraulic brake systems, required a good deal of engineering effort on the part of the manufacturers, but it was the sort of effort that routinely goes into matching a braking system to new model. What was different were the criteria used in selecting the braking systems and the number of models which had to be re-engineered in a short period. Though manufacturers had apparently never designed cars with fuel system integrity as a strict constraint before revision of MVSS 301 was issued, they knew that at the impact speeds specified in the revision their existing models would retain their basic structural integrity. The manufacturers could then expect that compliance would perhaps require selective reinforcement or relocation of
the fuel tank, rerouting of connecting lines away from areas where they would be severed in a collision, and the addition of check valves. They knew how to go about finding the required modifications using a "cut-and-crash-test" approach. Similarly, there was no doubt that locking steering columns were possible on any car, although some engineering effort was required to design new columns, integrate them into the surrounding vehicle, and change the production process to accommodate these changes in the product. Each of these changes were examples of technology embodiment. None deserves to be ranked with new automotive technologies, as electronic ignition, high strength steels, automatic transmissions, and the first energy absorbing steering column once were and as ceramic gas turbine parts and mass produced Stirling engines may be in the future.

Technology embodiment does not preclude having to rely on experimentation to resolve uncertainties. Very few designs that must give a certain crash performance can be made final without experimental determination of their actual crash performance. The state of the art of structural design still relies on such experiments. But there is fundamental difference between repeatedly crash testing prototypes in order to find how thick a certain steel member must be made and repeatedly testing variations of a new composite material to find whether any will give the combination of cost, strength, and fracture properties that would allow it to replace the steel member. Eventually success is assured in the first case though the final thickness is uncertain; success is in doubt in the second case.
This distinction between technology embodiment and generation is not entirely satisfactory for several reasons. First, uncertainty exists in both even though technology embodiment is distinguished by being less uncertain. Uncertainty is greatest in the effect that achieving a set of attributes will have on other unconstrained attributes. Until the required modifications to fuel systems were found and incorporated into designs manufacturers probably had only guesses as to what they would cost. Uncertainty about the full effects of meeting a new set of requirements will be greater the greater the departure of those requirements from the current practice of the art. Second, it is difficult to observe technology embodiment in progress without observing new technology being generated at the same time. As engineers design door beams for one model they discover new ways of reducing cost and weight that can be applied to that model and to other models. Thus, the technology that eventually is used to achieve compliance with the requirements of a standard may not be the known technology whose embodiment would have been the only or best way to achieve compliance at first. This is particularly true for incremental innovative improvements to known technologies or design approaches that cumulatively result in new technologies. Third, what each manufacturer is capable of embodying depends on his own skill and knowledge; there may be different production spaces for each manufacturer. Finally, it is very difficult for an outsider to spot new concepts as they appear and distinguish them from old concepts that had just been unused previously. It may be difficult to unambiguously label a given technology as either new or previously known.
There are then two types of technological change. One is movement between existing points in the production space, the reducing to practice of technologies that are already part of the state of the art. The second is the generation of new points in the production space, making possible combinations of attributes that were previously not attainable. The new technologies generated in the second type of change may provide greater safety than was possible before or equal safety at lower cost or may affect only non-safety attributes. New technologies may also be generated which are inferior to known technologies. A new technology may or may not be embodied after it is generated. Whether it is determines the immediate impact of its generation of the attributes of automobiles as produced and sold. Embodiment may be prompted by either market forces or by regulation once a new technology becomes known.

Whether compliance with a new safety standard is feasible corresponds with whether a suitable known technology can be embodied by its effective date or whether a new technology can be generated and then embodied. Feasibility is certain only when just embodiment is necessary. Since feasibility is one precondition to practicability, a similar statement could be made about certain practicability.

One objective of automobile safety regulation has already been identified. It can be restated as the forced incorporation into new cars of safety attributes that can be achieved by known technologies whose overall effect on all attributes is considered desirable. This objective essentially seeks to take advantage of existing opportunities. A second
objective of regulation -- or rather of the Safety Act which also created the regulatory regime -- is to create new opportunities by generating new technologies which might provide still more desirable combinations of attributes. The legislative history of the Safety Act makes it clear that this goal was one of the reasons for providing for research and development by the NHTSA.

Meeting the first objective is done through regulation with safety standards. Chapter 5 discusses how the NHTSA has gone about achieving this first objective and the problems it has encountered. Chapter 6 does the same for the second objective, generating new technology. The primary method for doing this has been through research and development paid for or conducted by the government.
REFERENCES TO CHAPTER FOUR


9. The literature on innovation in the automobile industry may be accessed through Abernathy, William J., The Productivity Dilemma: Roadblock to Innovation in the Automobile Industry, Harvard University, Graduate School of Business, Boston, April 1976.

CHAPTER FIVE

FIRST OBJECTIVE: PUTTING KNOWN TECHNOLOGIES INTO PRACTICE

If the view of the NHTSA as having two objectives, to put desirable technologies into use and to generate new technologies which might also be desirable, is accepted then standards development is the process of accomplishing the first objective.

The NHTSA does not officially accept the view that its first objective should be to take advantage of opportunities for desirable changes as presented by known but unused technologies. It was mentioned in Chapter 4 that the NHTSA tends to see its official mission as consisting of a single objective: the reduction of traffic fatalities and injuries. It professes to use a range of programs, authorized by the various acts which it administers, to affect the "bottom line" of national traffic accident statistics. Motor vehicle safety standards are just one of the possible "countermeasures" that the agency may adopt; others are defect and recall proceedings, public education programs, and highway safety standards tied to federal grants to the states. The functional organization of the NHTSA's programs into a Motor Vehicle Programs Office and a Traffic Safety Programs Office tends to decouple joint consideration of some of these distinct types of countermeasures in practice. But the NHTSA's own working orders emphasize coordination between the programs via agency-level multiyear plans.1

93
However, as it goes about pursuing its single objective, the NHTSA in effect does tend to use motor vehicle safety standards in an opportunistic manner. In sometimes arrives at a candidate safety standard by simply pursuing reductions in traffic fatalities and injuries rather than examining technologies that might be desirable, but once the standard is proposed it usually does attempt to judge its desirability in terms of more that just its accident-reduction potential.

The three sections in this chapter analyze how standards development as the NHTSA views it is supposed to proceed, the inherent problems in developing standards and how the NHTSA tries to resolve them, and the consequences of the unresolved or unresolvable problems for the process and outcome of regulation.

5.1 The NHTSA Approach to Standards Development

Before describing the NHTSA's approach to developing motor vehicle safety standards for automobiles, it is worthwhile to briefly review two of the restrictions on the content of safety standards.* A safety standard can only set objective requirements, and only on the performance of a motor vehicle. A test of performance is objective if it is repeatable. Different persons conducting a performance test as described in a standard on the same vehicle must obtain the same results as to the compliance or noncompliance of the vehicle. Tests called for in stan-

* Section 2.2.1 contains the complete discussion of these restrictions.
standards thus must specify closely controlled test conditions so as to eliminate variations due to the test procedure and to isolated variations due to the tested vehicle itself. The exact nature of the restriction imposed on a standard by virtue of it being allowed to regulate only performance is not as clear. Standards presently exist which require the installation of particular types of equipment. Some specify distances and areas. The headlamp section of MVSS 108 sets dimensions and tolerances, but that should be considered exceptional.

There are four conceptual steps that can be generalized from the NHTSA's past efforts at standards development. The first step results in candidate objective performance tests and requirements for inclusion into a new standard or amendment. There are two approaches to accomplishing this first step. The first approach is through the identification of safety problems. While the overall problem from the agency's view is traffic deaths and injuries, it tries to identify more homogeneous categories within this overall problem which might be susceptible to common solution, e.g., postcrash fires or accidents caused by underinflated tires or injuries sustained by pregnant women wearing conventional seat belts. Problem areas come to the agency's attention through accident investigation, statistical analysis of accident reports, compliance testing, consumer complaints, and rulemaking petitions. The agency assigns priorities to problem areas as needed to keep its workload commensurate with its resources.

Once a problem has been identified the NHTSA determines what level and type of vehicle performance as defined by carefully controlled,
objective testing will be adequate to correct the actual problem on the highway. For example, once the NHTSA identified a safety problem caused by windshield intrusions, it had to devise a performance test suitable for inclusion in a safety standard that would correct the intrusion problem. In this particular case, the NHTSA had to determine what portion of the windshield area should not be penetrated and how much room was required in front of the windshield to allow for outpocketing when an occupant fractured the windshield from inside. The transition had to be made from inadequate vehicle performance on actual highways in complex, car-to-car collisions to requirements on vehicle performance in carefully controlled crash testing into flat barriers.

The second approach to completing the first step in developing a standard is to consider actual changes in vehicle design. Promising changes may be sought in response to specific safety problems, for example low tire pressure warning devices might be investigated and considered as a correction to the problem of accidents caused by low tire pressure. Or changes may be considered without any specific problem having been identified first. Ideas for changes in design may be collected by the NHTSA's own engineers and by research contractors specifically given that task. Other persons or automotive companies may also suggest promising changes. Obvious differences in the design of current models may also be a source.

Once a change is identified it is necessary to devise performance requirements that will have the effect of forcing the contemplated changes in design to be made. In this approach it is not necessarily the
fact that a vehicle is capable of achieving certain performance in a controlled test that assures correction of a safety problem. It may be that in order to provide that performance manufacturers must change their designs in ways that will have the effect of correcting the safety problem. For example, the performance test for side door strength had little to do the mechanics of actual side collisions, but it has the effect of forcing the use of side door beams which may improve crashworthiness in actual side collisions. Another extreme example is the test procedure for signal lamp light output. Only a few test points are chosen for measuring light intensity for each lamp; the test is more one of the design of the lamp bulb and lens material that of the actual lighting performance of the entire lamp. Using this second approach allows the NHTSA to consider promising safety technologies directly, without explicitly working backwards from an identified safety problem to the vehicle performance that would be required to correct the problem.

Some examples of the first step using the two different approaches will illustrate the difference. As just pointed out, the standard for windshield zone intrusion was motivated by observations of accidents in which dislocation of the engine hood through the windshield caused injuries that would not have occurred otherwise. The revision to the fuel system integrity standard was similar. Accident investigation confirmed the suspicion that rear-end collisions were as important as front-end collisions in causing fuel spillage. The headlamp concealment devices and accelerator control systems standards are two more examples in which specific performance failures were considered to be accident
hazards. In contrast, the proposed change to a three-beam headlighting system was the result of a general investigation of ways headlighting could be improved, motivated by the belief that better illumination might reduce accidents. The same sort of motivation was true for rear signaling systems; the first research contracts in that area evaluated the advantages of alternative systems rather than identified specific failings of the present systems that were contributing to accidents. There was once an ANPRM issued which contemplated standardizing horn signal intensity and pitch, with unique identifying pitches for different classes of vehicles. The lack of such standardization could never be observed to be a contributor to accidents, although it is conceivable that a well-designed field test might show a safety advantage for standardization. Numerous other examples of proposals and research projects that seemed to have skipped the problem identification step could be given. Part of the reason that there have been so many is that many problem areas were identified or hypothesized long before the NHTSA began its work and over the years ideas for correcting these problems accumulated.

The first step in standards development may result in more than one candidate for consideration, including perhaps alternatives that do not include vehicle modifications but rely on highway safety programs instead. The second step is to determine the effects of adopting each alternative or combination of alternatives. Possible remedies to problems and possible improvements not originated as remedies to specific problems are evaluated for their contribution to the goal of reducing
accidents, deaths, and injuries and for their effects on cost, non-safety aspects of vehicle performance, or other considerations. Even if the NHTSA were interested primarily in possible increases in safety, it must identify and consider the reasonableness of other consequences of adopting a remedy or improvement lest it be found to have acted arbitrarily in ignoring them. The third step in standards development is to choose the desirable candidate or candidates on the basis of the information produced in the second step. The fourth step is to go through the rulemaking procedures necessary to promulgate the new standards or amendments. A fifth step, in-use evaluation, is added sometimes to provide a check on the accuracy of the other four by measuring the effectiveness of the adopted standard once implemented.

5.2 Inherent Problems and Attempts to Resolve Them

It is possible for faulty execution and simple mistakes to cause the idealized process of standards development to go awry, and this has without doubt occurred many times. But there are more serious complications in the process which create difficulties in practice for which even faultless execution cannot compensate. Some of these difficulties have been more serious in the past ten years than they would have had to be, but their presence is unavoidable.

Objective Performance Requirements

When the NHTSA succeeds in identifying a safety problem through its accident investigation research it may run into difficulties devising
appropriate objective performance requirements for inclusion in a new or revised standard. In some cases the need is for a performance measure, a way of quantifying some aspect of vehicle performance. Examples of some existing performance measures are the head injury criterion, which is an integral function of the acceleration loads on an occupant's head during a collision, braking distance from a given starting speed, the angle of view provided by a rearview mirror, the strength of a seat when loaded in a certain way, the boiling point of a brake fluid, and the speed of flame spread on a fabric. In designing most performance measures it is necessary to very carefully control test conditions, for example in defining the angle of view provided by a mirror, the position of the driver's eyes relative to the mirror is critical to a repeatable test. In crash tests the loading of a vehicle may be important. The NHTSA relies on the performance tests of the SAE and other standards groups for many of its performance measures. It has also hired contractors to devise new performance measures, and its own engineers have done the same. A performance measure may be quite simple, for example the time required for an accelerator control device to return to idle when disconnected, or complex, for example a single figure of merit for evaluating the entire direct field of view provided by an automobile.

Once a suitable performance measure is available, it is necessary to choose the level of performance necessary to correct the identified safety problem. This requires accident investigation, biomechanics research on injury mechanisms, measurements of driver capabilities and vehicle mechanics, etc. The NHTSA relies on its own research and
research done by others. The presently proposed maximum allowable head injury criterion, for example, is the result of research by many groups. The same is true for the femur load limit. In many cases there is no threshold level of performance that will completely correct the safety problem at hand; instead, higher levels of performance would achieve successively greater reductions in fatalities and injuries. The speed of a barrier test crash is an obvious example. On occasion the NHTSA has tried to find the "required" level of performance in areas like these. For example, one contractor was asked to find the direct field of view required for safe driving. This insistence on finding the performance levels required for safety is consistent with the NHTSA's view of its task as the correction of safety problems; it is inconsistent with the view that regulation is supposed to make only desirable changes, which may still allow for fatalities and injuries of each particular type. In such cases, all levels should ideally be considered so as to choose the most desirable one. Obviously, the 30 mph crash tests required in the present standards do not necessarily solve all safety problems of the types addressed by each standard. They are instead some sort of compromise between what would be needed to prevent all fatalities and injuries and what can be achieved at various costs by present technologies.

Problems may arise in finding suitable objective performance measures in complex areas of vehicle behavior. It is an inescapable limitation of regulation dependent on objective performance standards that regulators cannot control product design decisions as completely as
can design engineers within each firm or as completely as they would be able to if the industry were a public enterprise and they were in control of product design. The restriction to objective performance standards limits the types of product changes that can be accomplished and raises the complexity of accomplishing those that still can be. The NHTSA's work in handling and stability is an example. The traditional practice in the automobile industry is to adjust the design of the handling-related parts of a vehicle until the desired performance, as judged by subjective testing, is attained. It is accepted that virtually any handling performance that might be desired can be engineered into a vehicle in this way. The NHTSA has said that it has identified by subjective testing and by comparison of statistics on roll-over accidents car models with dangerous handling characteristics. If the agency could simply impose its subjective judgments in place of those of the manufacturers of these vehicles it could solve the problem readily. Instead it has been working on developing objective performance tests for handling and stability at least since 1970 and has plans for several more years of work. The task is complicated by the number of test conditions that must be controlled, the difficulty in controlling them in realistic ways, and the number of separate but interacting performance modes that must be considered. The agency has succeeded in developing a few of the many performance tests it has been seeking and may eventually succeed with others in this area. But the cost in time and research effort has been high and the agency will likely never have a set of objective tests that will capture all the aspects of handling that are easily judged with subjective testing.
Feasibility

If the NHTSA has developed a set of requirements on the basis of the performance necessary to correct a problem, it must verify that the requirements are feasible within the state of the art. If they are not, a standard including them will not be practicable. It may also be the case that there is a technology which would give the required performance but that it is not desirable when all of its impacts are considered. The same may happen with design changes that are proposed as at least partial corrections to a problem or as simply promising ways of increasing safety generally. This is evidently the case with pedestrian protection. The simple elimination of stylistic protrusions and hood ornaments might prevent some pedestrian injuries, but the NHTSA has apparently concluded that such a change would not be desirable on the whole. Technologies that would give protection to a wider group of pedestrians are either unknown or involve undesirable changes in other vehicle attributes.

If no desirable technology exists for regulation to force into use, standards development cannot proceed. Effort should then be directed towards advancing the state of the art in hope of discovering a suitable technology. This has in fact happened with pedestrian protection. Although rulemaking by the NHTSA in the area is still officially active, there has been no announced timetable for its completion that has been anything more than wishful thinking. The research that is designated as supporting the rulemaking is in fact still exploratory.
If standards development is viewed only as a process for getting desirable known technologies into use, then it is disappointing but not embarrassing to find that no suitable technology exists in a given area of traffic safety. Cases like pedestrian protection appear to be failures only because of the NHTSA's view of its mission as being the reduction of traffic losses per se.

Predicting Impacts

The second step in developing a safety standard, determining the effects of adopting each alternative under consideration, implies the collection of large amounts of information, especially when there are several competing alternatives or if the most desirable level of required performance must be found. Even when only one alternative and the status quo are under consideration, the amount of information required to predict impacts is large. It is not surprising that problems arise in assembling this information.

The information needed is of two types. First, the desirable consequences of issuing a new standard should be known. These are primarily the reductions in the risks to individuals of accidental death and injuries and the reductions in income losses to a wide group of individuals when reductions in actual deaths and injuries and the claims they make on risk-spreading social insurance systems are achieved. The NHTSA does not attempt to predict impacts on individuals. Instead, it tries to predict the reduction in accidental deaths and injuries at the national level and calculates related income losses from this number using figures for average income loss per death or injury. Second, the undesirable
consequences should be known. These consist primarily of increased costs in manufacturing and operating automobiles.

There are two ways of obtaining the first type of information for a proposed standard. The NHTSA has used both on various occasions. One is to classify and count accident situations by type and to measure or predict the effectiveness of the standard's requirements in avoiding accidents of each type or in reducing injuries sustained in each type. Arithmetic then yields the national reduction in injuries and fatalities. This approach suggests itself naturally for vehicle modifications which are proposed to correct identified safety problems, since the relevant types of accidents will have already been defined and possibly counted. The NHTSA has formally used this approach to evaluate the consequences of the passive restraint standard,⁵ the indirect visibility standard,⁶ and the recent speedometer and odometer calibration and labeling proposal.⁷ A second way to predict the impact of issuing a standard is to field test modified vehicles and statistically compare their overall accident and injury records with a control group of unmodified vehicles. This also was and is being done by the NHTSA for rear signaling systems⁸ and has been proposed for polarized headlamp systems.⁹ A closely related approach is to take advantage of natural variations in the existing automobile fleet by statistically comparing accident records of models with different designs and performance. The NHTSA has attempted this for direct visibility, an area where significant differences in field of view are found among different car models.¹⁰
This might also have been possible for side door beams during the years when only a relatively few General Motors cars had them.

Both approaches have problems. For the last ten years it has been impossible to accurately count the occurrences of particular types of accident situations on a national level. This has been because the states' investigation and reporting systems are incomplete, not comprehensive, and inconsistent in their recording and classification of accidents. The NHTSA's own accident investigation efforts have been more clinical than epidemiological; they have been very good for defining accident types but the data bases they have produced have not been statistically representative of the national scene. They have hence been unable to reliably count the incidence of each type of accident. The NHTSA is in the process of designing and implementing an improved accident reporting and analysis system, including a National Accident Sampling System, that will help to correct this deficiency. It has also often been impossible to measure the effectiveness of candidate modifications in particular accident types, relative to each other or to present vehicles. It is fairly easy for crashworthiness modifications since once an accident occurs injury production or mitigation is a relatively deterministic problem in mechanics. But even in crashworthiness the variety of accident types causes problems, since small differences in road and vehicle design, collision speed, and vehicle and occupant orientation at the time of collision can affect injury production, thus multiplying the types of accidents that should
be considered separately. Also, although injury production is a
deterministic problem in mechanics, it is a very complicated one. The
impossibility of controlled laboratory testing of effectiveness with
human subjects means that reliance must be placed on anthropomorphic
dummies, cadavers, animals, computer simulations, and the poorly
monitored natural experiments offered by actual accidents. The NHTSA
tried unsuccessfully for several years to get funding for a project to
install crash recorders in a fleet on 100,000 automobiles, largely in
order to get better estimates of how vehicle behavior as measurable in
carefully controlled crash testing correlated with injury production in
actual on-the-road accidents. 11

In accident avoidance it is almost impossible to measure effec-
tiveness objectively without resort to statistical analysis of field
tests. Accident avoidance features on a vehicle always interact with
driver performance. The combination cannot be considered deterministic,
and despite attempts it has not been successfully modeled. 12 The only
conceptual drawback to field tests, whether of an accident avoidance or
of a crashworthiness feature, is that people's transient reaction to a
change may produce results that are unrepresentative of what would occur
at equilibrium with an entire fleet equipped with the feature. Of
course, a field test must be carefully designed to account for possible
interaction effects between modified and unmodified vehicles and to
ensure the statistical representativeness of the test samples. But field
testing takes time and resources to accomplish; since the normal accident
rate is very low, extensive and expensive testing is needed to get statistically significant differences between control and test groups. A multi-year field test of 12,000 automobiles with air bags has been possible only because General Motors lost money when it sold 10,000 of them to customers who were willing to pay $315 for the option. Had the NHTSA conducted such a field test as part of its research program it would have cost it more than $3,150,000, which is itself close to the agency's annual research budget for crash survivability. Even that field test has been insufficient to objectively demonstrate the effectiveness of air bags to everyone's satisfaction. Other field tests that the NHTSA has conducted have involved many fewer vehicles, on the order of dozens or hundreds. They have also used fleets of vehicles with questionable representativeness. The use of a taxi fleet, for example, makes reporting and record keeping much easier but questions arise with it as to the validity of extrapolating the results to privately owned automobiles.

The second type of information, that on the increases in cost necessary to produce compliance with a proposed standard, is in principle more amenable to acquisition. The automobile manufacturers have had to develop the capability for such cost estimation for their own planning purposes, though at least a preliminary design must be developed and verified before estimation is possible. The NHTSA must then either duplicate their capability and sources of input information in-house or get the cost estimates directly from the manufacturers. It has tried to do both in the past, with mixed success. Both cost information and cost-estimation techniques are carefully guarded information. Since 1974
the NHTSA may legally compel cost disclosures from a manufacturer, but only if he objects to an officially proposed standard on the grounds of excessive cost. Thus, the NHTSA would have to wait until it issued an NPRM before it would have the opportunity of forcing disclosure. The NHTSA has never actually used its disclosure authority. Manufacturers often volunteer some cost information, though not always in useful form. However, estimates of the initial cost of compliance usually have not been as major a point of unresolved disagreement as have safety impact estimates. The NHTSA recently was able to identify assumptions that it found questionable in some manufacturers' procedures for estimating the cost of air bag installation and was thus able to refute estimates that were substantially at variance with its own. Estimating compliance costs for the long run, after cost-saving innovations may occur, is much more difficult for even the manufacturers.

The NHTSA has coped with the lack of objective information in several ways. One common response has been to simply withhold decision on proposals until more information is acquired. There have been occasions in which subjective estimates of the effectiveness of proposed standards have been explicitly substituted for missing data in formal analyses. One example in indirect visibility occurred in January 1971, in what was still a fairly activist period in the agency's history. Another in speedometer labeling occurred in late 1976. These subjective estimates may represent the expert judgment of agency engineers and statisticians who have with experience acquired a special ability to make them accurately. But to the non-expert they can appear
arbitrary. For example, in the speedometer labeling case the estimate was that 5% of fatal, high-speed accidents involving young drivers could be prevented by restricting the maximum indicated speed on the speedometer to 85 mph, without changing the top speed of the car. Neither of the occasions mentioned have been followed by a new safety standard, so no check on the accuracy of the subjective estimates has been possible. The NHTSA has tried to use surrogate measures of effectiveness in some instances when actual measures were not available. This has been common in visibility and lighting areas, where comparative data on driver perception and reaction times and eye scanning patterns have been used to judge the superiority of one system over another. Surrogate measures like these can at best show that one system is better than another; in the case of rear signaling systems not even this has been possible. Surrogate measures cannot give quantitative estimates of fatality and injury reductions. By far the most common way of making do in the face of uncertainty has been to use subjective estimates of effectiveness implicitly in decisionmaking, without recourse to any formal quantification of safety benefits or compliance costs.

Decisionmaking

Eventually the NHTSA must decide whether or not to adopt a candidate standard once it has developed its performance requirements and predicted its cost and safety impact as well as it is able or chooses to do. The alternative, to postpone decisions indefinitely, is also possible, of course. As explained earlier, the Safety Act does not specify how the NHTSA should go about making its decisions. The Act placed few restric-
tions on how decisions are to be made once it is established that a proposed standard will increase safety and that compliance with it is feasible. Thus, one of the problems inherent in standards development is that of choosing how to make decisions. The NHTSA has not coped well with this problem. It has not established any desirability criterion that could provide it with a way of making individual decisions objectively consistent. Instead of deciding how decisions will be made, it makes decisions.

The discussion of desirability criteria in Chapter 4 suggested that cost-benefit analysis was a commonly used method of decisionmaking for government projects, and that ex ante cost-benefit analysis can in principle provide a workable desirability criterion for judging the type of changes that would result from the adoption of a candidate safety standard. The reason that discussion was as detailed as it was is that a type of cost-benefit analysis is as close as the NHTSA has come to a consistent desirability criterion.

The NHTSA does not claim to have adopted a cost-benefit criterion as the test of desirability of particular standards. To do so would be inconsistent with its own view of its mission. Instead, the NHTSA claims to use cost-benefit analysis to establish priorities among safety problems to be addressed in standards development. But the NHTSA performs cost-benefit analyses when the information required to do so for individual proposals is available, and it seeks the missing information that would make them possible when it is not immediately available.

In its early years the NHTSA tended to explain its decisions in the language of the Safety Act: the need for safety, practicable require-
ments, etc. During that period, subjective decisions were made on each proposal, usually without a formal analysis of its impacts. The first decision by the NHTSA to be explained in cost-benefit terms related to a proposed standard for rear underride guards on heavy trucks. In June 1971 the NHTSA withdrew the proposal, which had been outstanding for two years, and explained that it had determined that the costs of the standard would exceed its benefits if promulgated. Since then the agency has explained several more of its rulemaking decisions in terms of the balance of costs and benefits, though always without publishing the analyses or their numerical results. The Secretaries of Transportation have published formal cost-benefit analyses with recent passive restraint decisions. The NHTSA has attempted analyses for other rulemaking areas, both at its own initiative and after pressured urgings from other Executive Branch agencies. In 1976 the Secretary of Transportation directed all of his Department to in effect use cost-benefit analysis to review proposed regulations in order to ensure that they were "sound".

The NHTSA has never defended a rulemaking decision solely on the basis of a published cost-benefit analysis in the way a public works project might be, however. One reason is that the NHTSA can rarely defend its estimates of the safety and cost impacts as being accurate. Another is that for the NHTSA to say that the lives that would be saved with a standard are not worth the cost of saving them, which is what decisionmaking using its particular type of cost-benefit analysis would imply, would contradict the NHTSA's own view of its mission as the reduction of traffic fatalities and injuries.
Even the NHTSA's limited use of cost-benefit analysis has been very unpopular with Congressional oversight committees and with safety advocates. Opposition to the NHTSA's use of cost-benefit analysis by these groups appears to stem partly from disagreement with its neglect of equity considerations, partly from abhorrence of the seeming feelingless use of precise calculations to balance one man's life against a corporation's profits, and partly from dissatisfaction with the outcome of particular decisions that have been made on the basis of, defended with, or withheld because of the inability to perform a cost-benefit analysis.

The NHTSA's cost-benefit analyses are not the ex arte type discussed in Chapter 4. Instead, the agency uses an ex post analysis. The NHTSA has made an estimate of the loss in national consumption and investment due to the annual traffic fatalities and injuries and calculates from that estimate the average loss per injury of each severity level and per fatality. The estimate includes both consumption losses which could be captured in GNP and others, like loss to community activities of the voluntary contributions of time by injured and killed community members, that would not be captured in GNP since no markets for their exchange exist. Pain, suffering, and bereavement are not included. Expenditures like those for remedial medical care are not treated as consumption. The benefit of a proposed standard is taken to be the expected reductions in deaths and injuries multiplied by the estimated average loss for each. This benefit is then compared to the estimated compliance cost of the standard.
This sort of *ex post* analysis appears at first to be very different than the rigorous *ex ante* analysis discussed in Chapter 4. The NHTSA's approach does make it seem that the survivors of traffic accidents are reluctant to forego any of their own consumption to save the lives of the victims. The only concession made to the dead is that the personal consumption they would have enjoyed had they survived is recognized as no longer enjoyed by anyone. Actually, the results of one of the NHTSA's analyses would be identical to the results that would be arrived at if *ex ante* analysis were possible, but for some important flaws. First, the NHTSA's analyses in effect assume that individuals are indifferent to changes in the risks of future pain, suffering, and bereavement. This failing is recognized by the NHTSA. The agency was understandably unable to quantify in dollar terms the losses produced by actual pain, suffering, and bereavement and so it was forced to leave those out of its totals; it might have been more successful if it had tried to find individuals' values for reductions in the risks instead. Second, the NHTSA uses average losses where it would be proper to use marginal losses. Marginal losses should be less than average losses because of fixed overheads in insurance administration, police services, etc. Finally, in order to equate the results of the *ex post* and *ex ante* analyses, it must be assumed that all persons are risk-neutral, i.e. that they value changes in risk at the change in their expected consumption. This assumption seems unfounded and because the NHTSA does not recognize having made it, it is undefended. Individuals have generally been found to be risk-averse to changes in income. Their risk preferences for
lotteries involving the possibility of different types of death has so far been mostly a matter of conjecture only. The first of these faults suggests that the NHTSA's analyses place too low a value on reductions in deaths and injuries, especially injuries. The second works in the opposite direction. The effect of the third must be considered unknown but conceivably quite large.

Even with these flaws, the NHTSA's use of cost-benefit analysis can help to ensure that standards that would require a high expenditure per unit reduction in risk are not adopted before other standards that have a lower required expenditure and are hence more cost-effective. Any decision to reject a standard with an unfavorable benefit-to-cost ratio can always be explained in terms of cost-effectiveness rather than in terms of a value of human life.

It must be remembered that in many cases the lack of complete information, which problems in prediction make inevitable, prevents any sort of objective cost-benefit analysis from being performed. In some of the instances in which the NHTSA has explained its decisions in terms of the balance of cost and benefits without publishing figures for either, it is fair to presume the agency either used entirely subjective estimates of effectiveness in a formal analysis or simply chose to explain its subjective decisions in the language of costs and benefits.

Conflicts Between Interests and Ideologies

A final problem in standards development is that once a decision to adopt a standard is made it may be necessary to defend that decision against political opposition. The unanimous vote in favor of the Safety
Act in 1966 did not end all opposition to the concept of federal regulation of automobile safety. Replacing market decisions on the allocation of resources with centrally planned allocations always creates losers, both real and perceived. When the NHTSA issues a safety standard it restricts the perceived freedom of choice of car buyers. As the congressional revocation of the ignition interlock presumably showed, car buyers may not agree with the decisions that have replaced their own and may be able to overrule regulations. The public response to the NPRM on speed limitation indicated that a similar event might have occurred if that proposal had been adopted. There are also individuals who are ideologically opposed to automobile safety and other regulatory programs. These individuals are natural allies of individuals who are actually made worse off because of particular standards. There may also be individuals who agree in principle with regulation but who hold estimates of the impacts of a standard that are different than the NHTSA's. These people may also oppose individual standards.

More importantly, regulation will in almost all cases cause a reduction in the profits of the automobile manufacturers, for if a profitable change in design or pricing were possible the manufacturers would likely have already taken advantage of it. Most standards cause higher production costs and lower sales and profits. The only exception would be if the existence of a standard allowed the domestic manufacturers to operate even more like a cartel than they would be able otherwise. This seems unlikely and there is no evidence to support it. When the NHSTA regulates, the manufacturers lose. If they perceive a threatened loss as
serious enough they may take advantage of whatever political influence they have in Congress or the Executive Branch.

The Administrator of the NHTSA and the Secretary of Transportation are both political appointees who must be responsive to and will normally be sympathetic with the Executive Office. The NHTSA also depends on the Secretary of Transportation, the Office of Management and Budget, and Congress for approval of its operating budget. This means that there are channels through which political pressure may be put on the agency to make decisions it would not otherwise. Outright congressional reversals of agency actions are only one way that interests which would be harmed by a particular decision may find to influence or block a decision by the NHTSA. The interim adoption of the ignition interlock and the delay of the passive restraint requirement was the leading instance in which the agency was forced to implement decisions not its own.

It is also possible for affirmative political pressure to be put on the NHTSA in areas in which it has decided to take no action or has decided against adopting published proposals. This has been tried with success in standards for retreaded tires, school buses, and fuel system integrity. But there seems to be a lack of groups and individuals with political power who wish to and are willing to use it to influence regulatory decisions towards more safety at higher cost and towards more action in the presence of uncertainty, including the electorate. Congressional action on school bus safety and fuel system integrity was exceptional. School children and people who burn to death in otherwise minor accidents elicit special concern in many people. The public's
visible concern for the more common problems of automobile safety faded faster than has its environmental concern.

5.3 Consequences of the Unresolved Problems

The NHTSA has by no means been able to resolve all of the problems discussed in the previous section. Those that remain have affected both the process and results of regulation.

The NHTSA has relied on performance measures that quantify hundreds of narrow aspects of safety performance. Risks of postcrash fire in several collision modes, of side collision injuries, of several types of brake failure, of injuries caused by open glove compartment doors, by windshield glass, by control knobs, and by the steering column, of lamp failures, of whiplash injury, etc. are all controlled independently. This is in contrast to the concept of measures of overall on-the-road safety performance, perhaps expressed directly in terms of the risks of death and of each severity level of injury per accident and the risks of becoming involved in an accident. This reliance on narrow performance measures is natural. The various aspects of safe performance are fairly independent. The overall risk can only be observed through accidents and injuries caused by "failures" in narrow aspects of vehicle performance; the overall risk can only be affected by changes in narrow aspects of design; and prediction can only be made by considering the summed effect of many narrow aspects of design and performance, unless reliance is placed entirely on statistical analysis of field tests. Indeed, attempts
to quantify and measure overall safety performance even using the accident records of in-use automobiles have had only partial success; one attempt produced only relative rankings of models within each size class.\textsuperscript{26} The frequent use of the second approach to the first step in developing a standard -- consideration of particular design improvements -- also tends to encourage narrow performance measures.

The agency has also relied on performance measures that are at best tenuously related to their corresponding aspects of on-the-road performance. Postcrash fires are regulated with flat-barrier crash tests which are not realistic approximations to the more complex types of collisions that can occur between two cars or between a car and a fixed object. Side impact protection is regulated by a static crush test that has little relation to the dynamics of actual side collisions. The list could go on.

There are several reasons for the questionable realism of many standards. One is that actual accident situations are too varied and complex to exhaustively simulate in an objective, repeatable compliance test. So the NHTSA has kept the simple flat barrier for its crash tests rather than switch to a pole barrier or a contoured barrier. Another reason is that the agency has not had much success in working backwards from identified safety problems to the vehicle performance that would assure their correction. The windshield zone intrusion standard and the fuel system integrity standard contain the only examples of compliance tests that directly address a broad deficiency in vehicle performance with no expectations by the NHTSA as to what particular design approach
would be used to achieve compliance. Usually the NHTSA has had to take advantage of opportunities offered by particular design improvements, as Chapter 4 suggested would be a reasonable approach. When the NHTSA decides to force the use of a particular device or design approach, it can choose to use a contrived performance test which is not realistic but which does have the desired effect on design. Instead of a performance requirement that would ensure that an engine hood does not open while the car is in use, there is a standard requiring two-position engine hood latches. Instead of a side impact protection standard using a test dummy that actually simulated the injury modes that are important in side impacts, there is a side door strength standard that in effect requires door beams. Again, the list could go on.

The use of both narrow performance measures and unrealistic performance measures would not be a drawback if not for the effect of uncertainty in predictions of impacts and lack of complete information about the contents of the state of the art. If it were understood how the narrow aspects of performance or design contributed to overall safety and how the cost of a vehicle was determined by them, it would be possible in principle to devise a set of narrow and unrealistic performance standards that would have the effect of forcing into use any desired design and its associated overall level of safety. But when uncertainty exists, as it does in predicting the overall risk-reduction effect of most changes in narrow aspects of performance, having to rely on narrow performance measures introduces static inefficiencies. Put simply, too much may be being spent on preventing postcrash fires and not enough on better
braking systems. The use of cost-benefit analysis would avoid this situation, but the lack of certain predictions of impacts makes its use impossible.

Another inefficiency occurs when the NHTSA, because of misestimations of the safety impact of particular design approaches or because of ignorance of better ones, forces the use of a less than efficient design approach as a way of increasing a single narrow aspect of performance. When this happens manufacturers may be unable to adopt a better design because of the unrealistic performance measures that were used. Design of collapsible steering columns is an example of this; there have been claims that the present performance test in MVSS 203, while sufficient to force the use of what was thought a desirable design in 1967, is now preventing the use of cheaper, more effective designs.27

The lack of information on the consequences of the decisions it might make means that it is often difficult for the NHTSA to make decisions in which it can have confidence. In the early years of the NHTSA it was often considered sufficient that a performance change was effective against the problem it addressed, without the extent of the problem needing to be estimated accurately. In some cases there could be doubt about whether a change would increase or decrease safety. For example, the agency revised the seat belt standards to make it difficult for front seat occupants to wear a lap belt without a shoulder belt, in an attempt to increase shoulder belt use; it was not obvious that the effect of the revision might not instead cause a counterproductive reduction in lap belt use. Other areas involving occupant and driver
behavior presented similar problems. But in general the difficulties in precise impact prediction were not so manifest in those years. The difficulties have become much more obvious as attempts at more objectively rational and efficient regulation and planning have been made. One response to uncertainty is to simply not make decisions or to make decisions in the direction of the status quo. Since negative decisions will usually be made before an NPRM is issued, they will not often be visible. In at least one case, dealing with hydraulic brake performance requirements for non-automobiles, the NHTSA formally retracted an earlier positive decision on the grounds that it was uncertain as to whether benefits exceeded costs. Uncertainty has not stopped all decisionmaking, however. It was mentioned earlier that many of the NHTSA's decisions can only have been the result of subjective judgments that the favorable consequences of its decision would be worthwhile compared to the unfavorable consequences. While the NHTSA may feel confident of these judgments, the estimates of effectiveness implicit in them are not always correct. Studies of the in-use effectiveness of the side door beams which were forced into use by the side door strength standard have not been able to find any significant indication that they are effective at all. This may be due partly to problems in measurement, but it may also indicate that the beams are not nearly as effective as the NHTSA once believed them to be. Review courts do not insist that the NHTSA have succeeded in quantifying safety benefits. Standards must meet the need for motor vehicle safety, but courts have upheld standards on this point in cases where common sense indicated only that some improve-
ment in safety would result and the NHTSA's data was not much better. Two adverse court decisions, both on retreaded tires, did criticize the NHTSA for not demonstrating a safety benefit before issuing standards. But both of these cases turned more on the practicability aspects of the disputed standards than on safety impacts.

Several of the unresolved problems in standard development may occasionally combine to create a tacit bargaining situation between the NHTSA and the regulated firms. Bargaining may occur when each has a target outcome it would prefer, but would rather compromise that outcome than accept some other threatened result that could be forced upon it by the other bargainer. The NHTSA can be viewed as having in mind some form of the performance requirements that it would like to impose on the industry. The industry, in turn, would prefer to avoid further regulation. Although the NHTSA has the advantage of its legal authority, its position is not entirely secure. Because of the NHTSA's frequent inability to objectively demonstrate safety benefits for some of its proposals, it may often prefer to compromise than to be forced to explain and defend its proposals in court or before fellow agencies. Even if it feels certain of victory in a court challenge, the possibility of losing and the undesirability of becoming entangled and delayed can be enough to make implied threats of an appeals suit a bargaining tool for regulated firms. On the other hand, the manufacturers know that the NHTSA does have the legal authority to issue standards that could be very burdensome to them. They can challenge standards, but even if they win an appeals suit it is at the expense of possibly adverse public atten-
tion: There have been very few court challenges filed by the automobile manufacturers compared to those filed by smaller equipment and parts manufacturers. Also, it may be wise for the manufacturers to avoid giving the NHTSA opportunities to resolve its own uncertainties about how deferential review courts will be to its own actions. The manufacturers should also avoid stalemating rulemaking to the point where Congress finds it necessary to become involved.

The existence of a bargaining situation is important here because of the effect it has on the outcome of standards development and rulemaking. It is obviously possible that the NHTSA might adopt a more stringent starting position as a strategy. It may settle for less than it actually wanted, though changes in its preferred outcome due to newly acquired information can be difficult to distinguish from such concessions. Also, in a situation where each party would prefer a settlement to a conflict, arbitrary but obvious settlements are favored to result.31 Traditional practice is usually an obvious point at which to reach agreement. A flat barrier test at 30 mph was chosen for the windshield zone intrusion standard not because that speed was found to be necessary or best for correcting the intrusion problem, but because most past tests in standards were done at that speed.

There are, of course, rulemaking cases in which there is no obvious settlement agreeable to both sides but in which there is still a need to reach tacit agreement. In cases like these the problems of reaching agreement are worse and the arbitrariness of the outcome can remain. When the NHTSA has tried to change entrenched practices in areas where
many details of performance had to be revised, as it did in the revision of the hydraulic brake standard, the process has been complicated both by the real costs of change and by the necessity to reach agreement on each detail, for few of which did the NHTSA have an objective reason to favor a particular result. The problems in choosing and agreeing on a higher performance level when no single level is an obvious choice increases the difficulties of achieving technological change.

The lack of an objective and workable criterion for deciding the desirability of individual proposals has meant that decisions are made individually rather than systematically. There are two symptoms of unsystematic decisionmaking which are notable. One is that internal agency consensus-building becomes advantageous to the NHTSA. If there is no objective reason for deciding to take a particular action, internal objections must be heard and either resolved or neutralized. The alternative is for the Administrator to exercise his discretion in ways that will possibly appear arbitrary to outside observers, without the assured support of his agency. If internal agreement among key persons and offices cannot be reached it risks less to take no positive action, with the result being no technological change. The NHTSA has an elaborate procedure for inter-office review of proposals that has the effect of both spotting deficiencies in the work of individual offices and resolving differences between them. The second symptom is that decision-making and the steps that proceed it are more comfortably done behind closed doors. Since 1971 the NHTSA has not released its program plans. It has rarely issued support papers for its rulemaking decisions although
it prepares them for its own use. Only in the passive restraint decisions by the two most recent Secretaries of Transportation have formal analyses and position papers been published and defended.

A crucial consequence of the practical difficulties in telling what decisions are objectively correct or incorrect is that the Administrators of the NHTSA have by necessity and by opportunity taken advantage of the range of judgment allowed them under the Safety Act. Some Administrators have been aggressive regulators in the sense of being willing to impose relatively high costs on car buyers and corporate stockholders for risk reductions and of acting deliberately even when benefits and costs have been uncertain. It is evident that in the NHTSA's first few years, standards were sometimes adopted to correct identified safety problems with little consideration given to how frequent those problems were. In those years, the Administrators no doubt accepted relatively large costs to correct statistically minor problems, while knowing that they did not know the actual size of the problems.

Other Administrators have weighed the undesirable consequences of regulation more heavily and have not acted as readily when quantitative measures of benefits and cost were lacking or uncertain. An attentive reading of the report of the safety panel of the Interagency Task Force on Motor Vehicle Goals Beyond 1980 reveals that by mid 1976 there were new standards developed and ready to be proposed for indirect visibility, direct visibility, rear signaling, headlighting, seat belt injury criteria, and possibly side impact injury criteria and another major braking amendment. Most of these areas are ones in which the NHTSA has
already proposed standards; some sort of agency action on these early proposals has been expected for some time. The basis on which to decide the desirability of these proposals must be at least as complete as that for standards adopted in earlier years, yet Administrators in recent years have not acted on these standards.
REFERENCES TO CHAPTER FIVE

1. NHTSA Order 510-2, August 22, 1975.

2. Compare the four steps described here with the NHTSA's ideal sequence in the 1976 NHTSA Annual Report, DOT-HS-802 427, p. 49.


6. NHTSA Docket 71-3a.

7. NHTSA Docket 76-06.

8. See Voenodsky, J. "Rear-end Collisions Reduced: A Large-Scale Experiment Under Natural Conditions," 1974, SAE 740614;


10. See recent NHTSA memo in NHTSA Docket 70-7 on statistical analysis using the Digitek Figure of Merit.

11. The NHTSA's plans for the crash recorder program are reviewed in "Automobile Collision Data," Office of Technology Assessment, February 17, 1975. This report also discussed the NHTSA's accident sampling and analysis system.

REFERENCES TO CHAPTER FIVE
Continued


16. NHTSA Docket 71-3a.

17. NHTSA Docket 76-06.

18. See prefaces at 36 F.R. 22909; 37 F.R. 21328; 39 F.R. 10586; 40 F.R. 10483. But see also preface at 42 F.R. 36513, which does provide details on estimated costs and benefits.


20. Examples:

"Passive Protection at 50 Miles Per Hour," NHTSA, June 1972, DOT-HS-801 197, pp. 25-36;


mobiles. The manufacturers with the resources to do safety R&D on a large scale — Ford and General Motors — treat their own research findings as proprietary.

It is clear, however, that the total automotive R&D effort by the automobile manufacturers dwarfs that of the NHTSA. While the large domestic manufacturers are often accused of being slow to innovate, it is true that historically they have had a mastery of the technology of their products even when they were not actively using it. Being in command of automotive technology, even to the extent of themselves determining its pace of change, has been one way the large manufacturers have reduced the uncertainties of their industry, whether caused by competition, changing demand, or regulation. A manufacturer is better able to comment on and influence proposed regulations if he leads in the technology. Since the safety of an automobile is determined by very many aspects of its design and manufacture much of the manufacturer's R&D must be relevant to safety even though it may not be oriented towards safety.

There are some incentives for the manufacturers to consciously conduct safety R&D in particular. They have an incentive to find new ways of meeting established safety standards at lower cost or with less adverse impact on user convenience, style, or other attributes desired by car buyers. The manufacturers can successfully compete in the market on these aspects since consumers will respond to them. Some of these improvements can come from technologies that were previously within the state of the art but unused. A manufacturer may choose to comply with a standard initially by using a technology that is easy to switch to
quickly but is not the best of those that are available. Eventually the manufacturer will change to better available technologies. With short lead times manufacturers are forced to resort to easily made changes and wait until the next of the periodic redesign years to fully optimize each model. Changes within the state of the art may also be made in response to changing conditions, for example a new emphasis on fuel economy. But improvements can also come from new technologies developed through R&D, and the possibility of this is an incentive for the manufacturers to invest in R&D directed along these lines. Although it is difficult for an outsider to separate the two processes there are many examples where one or the other has happened. When it seemed likely in the early 1970s that a passive restraint standard would take effect within a few years, several manufacturers investigated possible alternatives for meeting the performance requirements without air bags. The bumpers first used to meet MVSS 215 were heavier and less attractive in appearance than those in use now; in addition, soft bumpers may gradually see more use. General Motors has reduced the cost of side door beams from $18 to $10 since they were introduced.¹ The design of collapsible steering columns was changed after their first year of universal use,² and several new designs have been suggested since.³ There have been instances in which manufacturers have asked the NHTSA to amend a standard so that an innovation could be used. The NHTSA amended the lighting standard to allow rectangular headlamps as a styling innovation and to permit the use of a different plastic for signal lamp lenses. The hydraulic brake standard was amended to allow a non-split system that had

25. See Reference 8 to Chapter 4.


28. 40 F.R. 18411.


32. NHTSA Order 800-1, February 2, 1977.

SECOND OBJECTIVE: GENERATING NEW TECHNOLOGY

If the current state of the art does not include technologies that would correct an identified safety problem, or if the technologies that would do so are not considered desirable because of their cost or other unattractive characteristics, it is natural to suppose that through research and development a new technology might be found that would be both effective and desirable. This thought occurred to safety advocates in 1966. As a result, government R&D to advance the state of the art of automobile safety engineering was one of the programs they fought for as the Safety Act was drafted. The committee reports on the Act made their victory explicit: the government was to develop its own expertise in motor vehicle safety capable of making independent contributions to the state of the art.

From the NHTSA's view of its assigned mission as reducing traffic losses, it would appear that the public goal of all R&D is to generate technology for improved safety. In fact, it is desirable that technologies be generated that are on the whole more socially attractive than the technologies that are presently in practice or which could be brought into practice. The main component of the attractiveness of a safety technology can be its ability to produce automobiles with lower traffic risks, so greater safety may be part of the motivation for R&D. But new
technologies which can provide the same level of risk as present ones but have lower costs or less adverse effects on other attributes of a car are also a worthwhile R&D goal. Generating new technologies with R&D costs, just as adding more safety with known technologies costs. But it is reasonable to suppose that investment in developing and then embodying a new safety technology might turn out to be just as profitable — in terms of the safety impact achieved — as an equal investment which merely embodies a known safety technology.

The distinction made in the previous chapters was that a given level and type of performance is achievable with known technology if manufacturers know how to create the vehicle designs, tooling, etc, that would allow cars to be manufactured with that performance. The previous chapters have not dealt with what is required to generate a new technology. There can be wide variations in what it takes to do this. In some cases advances in design and fabrication methods may be a prerequisite to a new technology. For example, automated methods of seam welding would allow greater structural crashworthiness at lower cost. Or a new device or material may allow greater safety; solid propellants have been developed to replace compressed gas for use in air bags, with better performance. In other cases, simply demonstrating for the first time a technology that depends only on known techniques can effectively expand the state of the art if no one were previously aware that it could be done. Similarly, if there were uncertainty as to whether achieving a performance level were possible, producing a design or a prototype vehicle with that performance
advances the state of the art even though it was discovered in the process of doing so that no inventive concepts or new techniques were necessary for success.

There is a sense in which a new technology is generated when someone discovers that a certain type of vehicle performance as measured in controlled testing will correct an on-the-road safety problem. The process of standards development discussed in Chapter 5 might be considered capable of generating new technologies in this sense.

The NHTSA's R&D has never been intended to replace industry R&D. Instead the NHTSA's program is supposed to provide a yardstick for measuring the industry's efforts, to stimulate more effort by industry, and to fill in holes caused by the industry's failings. It is appropriate to begin this chapter by examining the automotive industry's R&D before considering the NHTSA's.

6.1 Industry R&D Activities

It is not possible to describe the substance of the R&D activities of the domestic and foreign manufacturers, because little of the work they do ever becomes public. The SAE does publish technical papers on safety engineering by employees of the manufacturers, but these usually only describe how a manufacturer went about engineering the design and process changes needed to comply with a given standard. The sort of R&D that would advance the state of the art does not often appear in the trade press and does not appear in the designs of production auto-
acceptable reserve capacity in case of partial failure. The agency was in the process of allowing a transmission interlock as an alternative to the ignition interlock when it was interrupted by the 1974 amendments to the Safety Act.

There are also limited aspects and levels of safety that market forces and product liability worries encourage without assistance from regulation, and the manufacturers have an incentive to pursue these with R&D. The design of air bags will be only partly determined by the requirements that the passive restraint standard will place on them. Concerns about product liability and competition will be the only incentives for innovations that increase reliability and durability; the passive restraint standard will not regulate either.

Safety R&D programs can and have been used by the manufacturers to placate their critics. This was common around 1965 and 1966 when congressional committees were attacking the industry for not doing enough research that was explicitly related to safety. The gratis participation in the NHTSA's Experimenta. Safety Vehicle program by General Motors and Ford was no doubt also in part motivated this way. Ford at first declined to participate and then agreed to do so after its competitor did. While R&D programs that are motivated in this way can be expected to be mostly for show, there is always the possibility that they might stumble across something useful.

The manufacturers may even have an incentive at times to develop new regulatory technology, i.e., techniques the NHTSA can use in its job of controlling the design and performance of the manufacturers' products.
This task would normally be expected to fall to the NHTSA. Some regula-
tory technology can also be used by the manufacturers in designing their
products and may be developed by them for that purpose. The SAE stan-
dards and recommended practices were developed for the convenience of the
industry but their test procedures still form the basis for the bulk of
the NHTSA's performance tests. A very good example of a manufacturer
doing some of the NHTSA's work for it is that General Motors has
pioneered in anthropomorphic test dummies. It did this in part for its
own use, particularly during the period in which it considered marketing
cars with air bags; a good test dummy is a useful tool for designing an
air bag system even apart from compliance testing needs. General Motors
also evidently preferred, if the NHTSA were going to regulate passive
restraints, that it do so well instead of poorly. By developing better
test dummies for the NHTSA General Motors made it easier for the agency
to regulate it, but it also protected itself from the even more burden-
some regulation which might have resulted from dependence on less
realistic and repeatable test dummies.

Equipment and parts manufacturers can in some cases have very strong
incentives to develop new safety technology. If they can develop an
add-on feature or one for which manufacturers must or might rely on them
for parts and the NHTSA then chooses to regulate it into universal use,
they may create a large and profitable market for their product in a way
that never is true for the automobile manufacturers themselves. Develop-
ment of the air bag was carried through a critical stage by parts sup-
pliers. Research on automatic braking is being kept going partly in
hopes that a market for it may eventually be created through regulation. DuPont has developed silicon brake fluids that the manufacturers have chosen not to use in new cars; a large market will be created if the NHTSA ever decides that the advantages of silicon fluids outweigh those of their aspects that the manufacturers find undesirable.

The automotive industry as a whole does not have the full incentive that a perfect market would give it to pursue new safety technology, despite the assorted and limited incentives described above. As long as a market failure makes it unrewarding for the manufacturers to build, promote, and sell cars with the levels of safety that would be demanded in a perfect market there will be no compelling reason for them to find better ways of doing it. The manufacturers have good incentives to meet standards that are irrevocably in place by their effective dates but they do not have good reason to continually look for innovations that would go beyond the safety performance required by present, and anticipated, standards. Since the present regulatory system can only mandate performance that is practicable, or already within the manufacturers' capabilities, it cannot encourage manufacturers to extend their capabilities as well as a market that rewarded such advances would.

The standards that have been issued so far have created a disincentive for industry R&D that would not have existed if problems in developing good performance measures had been less intractable. It was explained in Section 5.3 that the NHTSA's reliance on narrow and unrealistic performance measures, combined with its uncertainty as to safety impacts and its lack of full knowledge of the state of the art, creates
inefficiencies in the safety standards. These inefficiencies also result in a lack of incentives for innovations. Generally, if a manufacturer cannot use a known and socially desirable technology to his own advantage because of unrealistic performance requirements which effectively admit only another technology, he has reduced incentives to invest in discovering new socially desirable technologies as well. If the NHTSA were able and willing to define broad performance measures instead of narrow ones, the manufacturers might be able to discover and take advantage of favorable tradeoffs between narrow aspects of performance to reduce the total cost of achieving a given overall level of safety. Or they might be able to provide a higher required overall level of safety at the same cost as for a lower level imposed through inefficient, narrow standards. The examples given above in which the manufacturers have petitioned for changes in standards to allow them to use other methods shows that standards can prevent innovations from seeing use. It is unknown how many innovations were prevented from discovery because of the limitations of the existing standards. The NHTSA's lack of success in standards development means that it must carry a greater burden in the generation of new technologies, since its standards deprive manufacturers of some incentives to do R&D that they would otherwise have.

The existence of the regulatory regime can even discourage some innovations that would have been forthcoming under the failed and unregulated market. A safety feature that would have been profitable if offered as an option but which would reduce profits if forced into use on a manufacturer's entire production may never see any use at all and may
never be the object of an R&D program. The risk of the NHTSA noticing the feature and finding it more desirable than do car buyers may be too great. Speculation suggests that something of this sort may be the explanation for General Motor's early enthusiasm and late antipathy for passive restraints. As a luxury option on Buicks and Cadillacs air bags might conceivably be profitable; as a standard feature on Chevrolets they almost certainly would not be. General Motors has not introduced a major new safety feature on its own since it introduced side door beams. Ford's one significant new idea for a safety feature was the ignition interlock. Whether the manufacturers have stopped the sort of R&D work which produced the side door beam, whether they have continued with it but have had no comparable successes, or whether they have discovered comparable improvements that they have chosen not to use or publicize, is a matter of conjecture. It is certainly possible that the manufacturers may have discovered new technologies whose use they consider not privately profitable but which the NHTSA would consider desirable.

Since whatever safety R&D that the manufacturers do is not reported publicly there is no way for the NHTSA's R&D to be used as a yardstick for the industry's efforts. It is also impossible to identify gaps in the industry's R&D that would be appropriate areas for government R&D. The NHTSA must assume that any area in which it does not know of any industry R&D program is not being explored by the manufacturers.
6.2 The NHTSA's R&D Activities

The NHTSA tends not to define as a separate category R&D aimed at advancing the state of the art to create new and possibly desirable alternatives for consideration in future standards development. In the agency's view all of its R&D is related to present standards development. Since the agency has started standards development in a great many aspects of safety, most of its R&D is so related. Within this category, however, there are differences. Much of what the agency calls R&D is what the previous chapter calls information gathering: accident investigation, biomechanics research, determination of performance levels necessary to prevent accidents or mitigate injuries, experimental or analytical estimation of the effectiveness of proposals for standards, testing and demonstrating that proposals are within the state of the art, learning what the industry already knows. This kind of R&D is very closely supportive of standards development that is aimed solely at getting known technologies into practice. Demonstrating that proposals are within the state of the art may occasionally make them so, if the demonstration resolves uncertainties. Another large part of the agency's R&D is aimed at developing new regulatory technology for its own use in standards development, rulemaking, and enforcement. This includes R&D on objective performance tests, anthropomorphic test dummies, accident investigation techniques, compliance testing shortcuts, etc.

The NHTSA has done some R&D that was intended to achieve safety performance that previously had not been achieved, and to develop design approaches that had never been tried before. The focus of this research
generally has been determined by safety problems that the agency has
thought to have high priority. Much of it has dealt with restraint
systems and structural crashworthiness. Examples from restraint R&D
include improved inflation techniques for air bags, air bags for motor-
cycles, inflatable head restraints, inflatable seat belts, passive belts,
seat belts with force-limiting devices to increase their energy absorp-
tion, seat belts intended for use by pregnant women and for small children, collapsible dashboard structures and steering columns, and anticipatory crash sensors for better actuation of inflatable restraints.
Structural crashworthiness examples include techniques like plastic hinge
design for getting more energy absorption with available material and
space, structures for deflecting the engine under the passenger compart-
ment instead of through it, and novel side structures. There has been a
long series of contracts that have developed structural improvements for
frontal, side, rear, and roll-over collisions by modifying limited
portions of production models from each size class. It is not completely
clear how much of this latter type of research has advanced the state of
the art and how much of it has merely explored or documented the existing
state of the art. The NHTSA has been interested in the possibility of
passive protection at 50 mph for many years and has done R&D on matching
structural crashworthiness and restraint system improvements in ways that
would make this possible.

Besides investigating pedestrian injury mechanisms and criteria in
an effort to determine what performance would be required to provide
pedestrian protection, the NHTSA has looked for ways of modifying auto-
mobiles to provide protection. The research has included work on soft bumpers, padded engine lids, and optimal front-end profile. While not actually paying for development work on radar-actuated braking systems the agency has encouraged development by issuing contracts for evaluation of systems developed by others. In an area in which manufacturers have little reason to be interested, the NHTSA has investigated ways of achieving greater car-to-car crash compatibility. The NHTSA's ultrasonic testing technique for tire casings is a good example of its development of a new technology that would provide greater safety. With the technique retreaders could raise the quality of their products at little extra cost by selecting used casings more carefully. The NHTSA could impose performance standards on retreaded tires that earlier would have been unattainable at reasonable cost.

The research just described has been aimed at improvements to vehicle subsystems. The NHTSA has also conducted research and development on entire vehicles. The Experimental Safety Vehicle and Research Safety Vehicle programs have been the two largest of all the agency's R&D projects. The ESV program was many things to many people, but in retrospect it seems to have been intended to prove that a large increment in structural crashworthiness was within the state of the art. The NHTSA set quite stringent specifications for crashworthiness and asked its contractors to meet them subject to weight and other constraints. The contractors generally achieved the crashworthiness goals except for some problems in refining air bag designs, but seriously exceeded weight targets. The construction of the American ESVs apparently did not make
or prove anything possible that was not thought possible previously, although without doubt no one had built automobiles to specifications like those set for the project and no one had used some of the design approaches used by the contractors. The ESV program was supposed to develop a systems engineering approach to making optimal tradeoffs between different aspects of safety performance. If it had, that would have constituted a quite significant new regulatory technology. In fact, though, each aspect of performance was controlled directly by the ESV specifications, so no tradeoff discovery was needed or allowed from the contractors.

The Research Safety Vehicle program was designed after the failures of the ESV program were evident. The RSVs are in a smaller vehicle size class than were the ESVs and the NHTSA made it much clearer to the RSV contractors that the weight constraint was a real one. There is some ambiguity as to the intentions behind the RSV program as well, however. It is not clear whether the RSV program is intended to find and prove the feasibility of the most desirable balance between safety, cost, fuel economy, and emissions for the mid 1980s or whether the program is itself intended to produce the new technology which will make it possible to reach goals for that period that will or have been set elsewhere. There has been some disagreement between the NHTSA's Office of Motor Vehicle Programs and its Office of Research and Development on this definitional issue and on whether the RSV project would yield results that could be used in standards development as it progressed or only once completed.

144
Two American RSVs are being constructed. One, by Calspan, is a modification of a Chrysler Simca. What its designers have done is to upgrade the structural crashworthiness of the Simca in the most advantageous ways they could find, subject to limitations on weight and cost. They have, in effect, taken advantage of the most desirable technologies available. The result is substantially greater crashworthiness with relatively little weight penalty. This is in contrast to the ESV project, where designers worked to fixed targets in crashworthiness. The designers of the Calspan RSV boast about how realistic it is compared to the ESVs. The vehicle is conventional in basic design; its features are well within the state of the art of design and manufacturing. Chrysler believes a close version of the car could be successfully mass produced and sold.

The second American RSV, being built by Minicars, is quite different. Its structural crashworthiness is comparable to the other RSV but it is unconventional in design, materials, and manufacturing techniques. The relevance of this RSV to mass production and sale of safer automobiles is not obvious but may exist.

A Volkswagen Integrated Research Vehicle, which would have been an RSV if Volkswagen had won its bid for one of the NTHSA contracts, is like the Calspan RSV in that it is essentially a modified production vehicle, in this case a Volkswagen Rabbit. The modification has been done with careful attention to opportunities for improved safety. The safety performance of this car is similar to that of the other two.
All three vehicles are being used as contexts for the development or refinement of new subsystem technologies and devices: advanced air bags, passive belts, inflatable belts, force-limiting belts, interior padding, anti-skid brakes, radar warning systems, rigid foam as a structural element, etc. They also serve as a context for refinement of some damageability, fuel economy, and materials recycling concepts. But as a whole the RSV program has just very carefully selected and integrated technologies that were already within the state of the art (with the possible exception of the Minicars RSV which may still be outside the state of the art of automobile manufacturing when the project is completed). The effect of doing this selection and integration for the Calspan and Volkswagen RSVs might legitimately be called new technology because it has demonstrated what net result is achievable and resolved uncertainties. But if it is a new technology, it may only be new technology for producing safer Chrysler Simcas and Volkswagen Rabbits. It is unclear that the RSV project would make it easier to perform the same modification process on another car of the same weight class or to a car from another class. It is also unclear that if the crashworthiness of a Ford Pinto were optimized subject to similar weight and cost constraints it would give the same level of performance as the Calspan RSV, or that achieving the same performance in a Pinto would have the same cost penalties as it does in a Simca.

The NHTSA has not devoted a very large portion of its research budget to the type of research described above. The ESV and RSV programs have been by far the largest portion of this type of research. One good
reason why the agency has not pursued new technology with more effort is that its rulemaking activities have demanded most of the available R&D resources for gathering information and producing new regulatory technologies. Simply discovering what is within the state of the art and what it can accomplish towards greater safety takes considerable effort for an agency that must rely on contractors to do its research.

Under the interpretation adopted in Chapter 4, the objective of agency R&D aimed at generating new safety technology is to provide new alternatives that might be found desirable enough to be worth forcing into practice via standards. The NHTSA's R&D has not produced any new technology which subsequently was forced into use on automobiles. In ten years, there has been no standard issued by the NHTSA for automobiles which, but for earlier R&D performed by the NHTSA, could not have been met by the manufacturers on its effective date. The NHTSA also has never required the use of a device it was the first to develop. There three reasons why this has been so.

The first is that automobile design and manufacturing is a mature technology that probably has few surprises in store for itself. There are exceptions to this statement, notably in materials, engine technology, and automated manufacturing processes. Almost all of the concepts which have appeared in NHTSA rulemaking proposals and research projects -- air bags, polarized headlamps, three-beam headlamps, periscopes, etc. -- were around as ideas before the NHTSA came into existence. Any major new concepts that will be developed to the point of being part of the state of the art will probably be developed by firms in the industry.
The second reason is that many of the advances that were made by the NHTSA's R&D were ones which were not appropriate for regulation. There are two ways in which R&D can be inappropriate. One was is that the NHTSA's regulatory tools and abilities may be inadequate to handle the technology developed in R&D. A manufacturer, who can control every design detail and use subjective judgments in testing performance, can put into practice any known technology he desires and can afford. The NHTSA's restriction to objective performance standards means it cannot do this as easily. For example, the NHTSA's R&D Office has experimented to find the front-end profile which minimizes pedestrian injuries as determined in computer simulations. It is unlikely that a review court would allow the NHTSA to issue a standard requiring that profile; the available anthropomorphic test dummies are not suitable for using in a pedestrian protection test, either. The complexity of regulating a technology can also exceed the NHTSA's capabilities. It would require a very complex set of standards for the NHTSA to force Chrysler to make all of its Simcas like the Calspan RSV, because of the number of design details for which performance tests would have to be devised. The second way that the results of an R&D project can be inappropriate is if the NHTSA would never find their imposition on the manufacturers desirable. If the NHTSA had issued an equipment standard for special seat belts for pregnant women it is doubtful how many would have purchased and installed them. The NHTSA would never make automobile manufacturers install them in every car.
The third reason is that regulatory decisionmakers have so far chosen not to adopt some of the R&D results which might have been suitable for incorporation by standard. Of course, regulation is not yet completed; the RSV projects are supposed to influence rulemaking in the early 1980s. If 50 mph passive protection were ever mandated, manufacturers might, for example, find the NHTSA's structural crashworthiness research useful.

6.3 Technology Forcing

The pattern of regulation as discussed so far assumes either that when a standard for a particular performance level is issued, manufacturers will already be able to meet that level on time through a process of technology embodiment or that the NHTSA does the R&D needed to generate a technology capable of providing that level before it issues the standard. There is another pattern possible, that of "technology forcing". In this second pattern, the NHTSA would set a performance level that it believed to be "necessary for safety" but which it knew or suspected could not be met within the current state of the art, i.e., that technology embodiment would be insufficient to enable the manufacturers to comply. It would then be incumbent on the manufacturers to do the R&D needed to generate a new technology capable of achieving compliance if such a technology were at all possible. In this way the NHTSA would be able to harness the massive creative capacity of the manufacturers instead of relying on the admittedly less massive capacity of its con-
tractors. Technology forcing also shifts the costs of developing a new technology onto the manufacturers' and off of the NHTSA's research budget. Technology forcing as described here has been the distinguishing characteristic of the regulation of automobile emissions since passage of the Clean Air Act Amendments of 1970, which set what were believed to be the emissions levels necessary for the protection of public health independent of considerations of what was thought to be technologically possible at the time. There are traces of technology forcing in automobile fuel economy regulation as well.

There has been some dispute as to whether technology forcing has been, could be, or should be used in automobile safety regulation. In regard to the question of whether it ever has been used, the answer must be no, at least not intentionally. The only case that came close was with the first version of the passive restraint standard, which pressed hard upon the manufacturers. In that case, it was clear that the NHTSA believed that air bags were a known technology capable of achieving compliance with the performance requirements of the standard; indeed, in large part the performance requirements had been designed with the capabilities of the air bag in mind. The passive restraint standard did place an enormous burden of technology embodiment onto the manufacturers; under the original leadtime schedule it may have even been physically impossible to comply in time and if compliance were possible the form it took might not have been very desirable. The size of the burden has led some to think that new technology was having to be generated. This was not so. The manufacturers were generating new technology, but it was
technology that would make compliance less burdensome to themselves. Compliance as such was already possible, though costly.

The court of appeals which remanded the standard upheld the NHTSA's determination that airbag technology was sufficiently developed to make compliance possible even though substantial commitment of resources to technology embodiment would be needed. Unfortunately, the court of appeals confused the cases of (1) a technology which exists and is in practice, (2) a technology which exists, is not in actual practice but which could be put into universal practice through technology embodiment, and (3) a performance requirement for which no technology currently exists and hence must be found through invention and R&D. Because of the confusion the court's opinion is extremely susceptible to a reading that technology forcing is allowed by the 1966 Safety Act and that it was in fact occurring in the case of passive restraints. While such a reading is comforting to safety advocates, and to the NHTSA, it is not consistent with the practicability requirement of the Safety Act. Practicability has been treated as a factual issue by every court: either a standard is practicable, i.e., it can be met by the effective date if sufficient resources are devoted to the effort, or it is not practicable. The Safety Act requires standards to be practicable when issued. The essential characteristic of the generation of new technologies is that sometimes efforts at it succeed and other times they do not. A standard can hardly have been practicable when issued if by the time of its effective date its performance requirements have been found physically impossible to meet in mass production. If the ability to comply by the
effective date is a certainty the day a standard is issued, achieving compliance is a matter of technology embodiment, not of the generation of a new technology.

The NHTSA had never issued a standard for which it believed compliance depended on generation of new technology. It may well have been mistaken in that belief in some cases and thus inadvertently attempted to use technology forcing. Nor has the NHTSA shown any interest in using technology forcing. The industry, of course, believes technology forcing should not be used as a regulatory approach. Some safety advocates have expressed more favorable thoughts on whether technology forcing should be used, though it is possible to interpret their statements as no more than support for vigorous regulation based on technology that they believe already exists. Safety advocates have always tended to have a more optimistic view of how much is possible with existing technology than do most other groups involved in automobile safety regulation.

A more critical appraisal of whether technology forcing would be a good way to generate new technologies shows several problems with the approach. For one, it is probably illegal under the Safety Act, although laws can be changed and even under existing law the courts might allow it. Second, it is most effective when broad and realistic performance measures are available, as they have been in emissions where all that matters is what comes out of the vehicle, and least effective when the only available performance measures are narrow, as they are in automobile safety. This is because a broader performance measure admits improvements from a wider set of innovations. Third, since technology forcing
must necessarily be begun under uncertainty, the agency using it must be able and willing to take advantage of new information as it develops and to abandon goals that prove infeasible or too expensive. In particular, the agency must be able to distinguish between a socially desirable technology and a technology that will achieve the originally required performance level. Finally, technology forcing is perhaps the most unpleasant form of regulation possible from the regulated industry's viewpoint. The political opposition to this type of regulation would be more determined than the opposition to other, less unpleasant types.

The history of automobile emissions regulation is a demonstration of the problems inherent in technology forcing. Of course, it can work to generate new technology; new emissions control technology has been developed since 1970 and more seems on its way. Whether the cost of generating it through technology forcing was worthwhile and whether the technology that has been generated was the best that could have been are as much debated as whether the approach should have been used at all. Technology forcing in emissions regulation has not achieved the levels of emissions thought to be "necessary for health" in 1970, however. The 1977 Amendments to the Clean Air Act abandoned the original goal for emissions of oxides of nitrogen.
REFERENCES TO CHAPTER SIX


6. There is as yet no concise and complete description of the Research Safety Vehicle program. Lengthy contractor reports and short NHTSA press releases are easily located, however.


CHAPTER SEVEN

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The appraisal at the end of the overview given in Chapter 3 suggested that on initial review not much change in the characteristics of automobiles has been achieved by automobile safety regulation since the promulgation of the initial safety standards. These initial standards were unique in that they were effectively put in place by Congress rather than by the NHTSA; the achievement they represent is not one that can be credited to the continuing regulatory regime. Once established and given a start with the initial standards, the institutions and procedures established to partially collectivize design decisions for automobiles seemed on first appraisal not to have caused anything more than quite restricted effects on automobile design. But even their limited accomplishments — bumpers, hydraulic brakes, fuel system integrity, side door beams, windshield zone intrusion — came about only through a process of regulation that was usually confused and factious.

Both of these observations in the earlier appraisal are true and few people familiar with the NHTSA's history would contest them. The purpose of the intervening chapters has been to examine the process and accomplishments of automobile safety regulation in relation to inherent problems and possibilities, since it would be unfair and unhelpful to judge accomplishments apart from possibilities. Having made that examination
it is possible to summarize and to offer some conclusions and recommendations on automobile safety regulation.

7.1 **Summary**

In 1966 Congress began a new regulatory regime in automobile safety. The National Traffic and Motor Vehicle Safety Act, passed in that year, established a mechanism which could substitute collective decisions made by government regulators for private decisions made by automobile manufacturers and buyers. Responsibility for using this mechanism was given to the Secretary of Transportation and through him to the Administrator of the National Highway Traffic Safety Administration (NHTSA). Congress imposed only weak constraints on the motor vehicle safety standards which the NHTSA might issue. Standards must be practicable, be appropriate to the item regulated, be stated in terms of objective performance criteria, and meet the need for safety. The authority granted the NHTSA was quite broad and thus regulation could conceivably affect many aspects of automobile design and performance.

Congress also directed that a particular set of existing private and government standards, representing familiar safety features all of which had previously seen at least scattered use, be promulgated as initial safety standards. It left decisions to issue further standards to the NHTSA's initiative.

The goals which Congress gave to the new regulatory regime were more symbolic than operational. It set as the objective of the Safety Act the
reduction of traffic accidents, injuries, and fatalities but qualified that objective by requiring the NHTSA to consider the reasonableness of cost, feasibility, and lead time. It explicitly noted that the goal of greater safety was not to be a reason for eliminating inherently less safe types of automobiles like convertibles. It thus implicitly admitted that considerations of user satisfaction as well as cost might affect the nominal goal of injury and fatality reduction. However, the NHTSA for the most part has held onto the "bottom line" interpretation of its mission as the simple reduction of traffic fatalities and injuries. It is forced by law to consider both costs and safety impacts of its decisions to issue standards and has generally done so, but only recently has it attempted to objectively weigh the two against each other through cost-benefit analysis. These attempts have not been entirely spontaneous; they were in part the result of pressures from other parts of the executive branch. The NHTSA has not relinquished the "bottom line" interpretation during this recent period.

For the NHTSA to successfully have a beneficial effect on the design of automobiles it must perform four tasks. It must develop the performance requirements which comprise the technical substance for standards. It must analyze and predict the impacts of a decision to adopt a proposed standard. It must make a decision to adopt the standard. And it must be willing and able to defend its decision successfully against political and legal challenges.

There are many problems that must be faced in completing the first task of developing the performance requirements for new standards, all
essentially technical. Accidents must be investigated and analyzed to discover safety problems; injury mechanisms must be studied to discover what vehicle performance is required to ensure that human tolerances are not exceeded; objective performance measures and tests must be developed; etc. The NHTSA tries to set requirements on the performance of an automobile as a whole which will ensure the correction of identified safety problems. It has instead more frequently had to set requirements on the performance of individual pieces of equipment and to in effect specify design approaches rather than minimum performance levels.

Second, there are problems in predicting impacts which the NHTSA has not overcome. Predicting the future is always difficult. In the case of automobile safety it is made difficult by a lack of information on presently occurring accidents and ignorance about the effect of proposed modifications on the frequency and severity of those accidents. The prediction of the impact of accident avoidance modifications is complicated by interactions with driver behavior and highway environment, prediction of the impact of crashworthiness modifications by the vast number of accident types and the impossibility of experimentally testing injury production in human subjects. The NHTSA cannot estimate costs as well as can the manufacturers, who have the advantages of experience and the information needed as input to estimates. Predictions of long run costs, which eventually dominate the more immediate short run costs, are made uncertain for both the NHTSA and the manufacturers by the possibility of cost-reducing innovations.
The third task which Congress left to the NHTSA was to decide the desirability of adopting individual proposed standards. The NHTSA cannot make these decisions mechanically, because Congress did not give it an objective decision rule for deciding the reasonableness of costs and because the NHTSA rarely is successful in confidently predicting cost and safety impacts. In the first few years of the agency, costs were apparently required only to be "reasonable" and safety impacts did not have to be quantified before affirmative decisions were made. Later attempts at cost-benefit analysis of proposals made it more obvious that uncertainty in impacts was a major problem in decisionmaking. It seems evident from the NHTSA's history that, faced with the lack of a decisively controlling decision rule and the lack of certain knowledge of the outcomes of alternative decisions, different Administrators of the NHTSA have made decisions that are not fully consistent with one another's. Outright repudiations of past decisions have occurred in only a few cases. But early Administrators made decisions to adopt and propose standards that probably would not have been made by more recent Administrators.

The NHTSA has not been entirely successful in the fourth task. It has had some of its decisions overruled by Congress and the White House. It has won some and lost some of the legal challenges to its standards as well.

The NHTSA should be interested in generating new technologies as well as in forcing adoption of already known technologies. The automobile industry does not have much incentive to invest in R&D that would
discover and develop new safety technologies or to adopt them once
developed. The NHTSA has no way to force the industry to do R&D that is
not specifically aimed at compliance with an actual or anticipated stan-
dard. Most of the NHTSA's own research budget has had to be devoted to
gathering and analyzing information and to developing new regulatory
technologies. It has done some R&D on new automobile safety tech-
nologies, but none of them has been forced into practice via a safety
standard. The NHTSA's Research Safety Vehicle project has achieved that
considerable improvement in crashworthiness without making the patently
outrageous sacrifices in other desirable attributes that appeared in its
earlier Experimental Safety Vehicle project. The trade off between
increased safety and increased cost represented by the modifications to a
Chrysler Simca during the RSV project may be more efficient than any that
were known to be possible before the project. An equal amount of R&D may
be needed for other models before they can be modified in similar ways,
however.

The NHTSA's R&D efforts must deal with problems of uncertainty
familiar in all R&D programs, whether in the private or public sector.
The agency cannot know which R&D projects will be successful in
developing new technologies. The NHTSA also faces the same analytical
difficulties in evaluating a new technology which might result from an
R&D project as it does in evaluating alternatives involving only well-
known technologies. It is thus difficult for the agency to rationally
and efficiently allocate the limited resources it has available for
exploratory R&D.
Added to these complications in R&D are ones peculiar to a regulatory agency. The NHTSA must rely on outside contractors to perform its R&D. This creates coordination problems with which most private firms do not have to cope. Research contractors who are not actively involved in manufacturing naturally are not as familiar with automotive technology as the manufacturers. The fact that exploratory R&D and research needed to support active rulemaking are handled by the same office within the NHTSA has allowed R&D projects whose exact purposes were ill-defined to proceed to completion. Such projects can easily produce results that have little use in either supporting rulemaking or generating new technology.

The outcome of a decade of regulation by the NHTSA under these circumstances is that few standards have been issued since 1968. The standards that have been issued cover limited aspects of safety performance. In some cases, like collapsible steering columns, present standards may be preventing reductions in manufacturing costs, injuries, and fatalities. The only standard on structural crashworthiness in side impacts, the side door strength standard, forced the adoption of a design approach that may not be nearly as effective as the agency must have once believed it to be. The recently issued passive restraint amendment will be the first standard to force the use of a safety feature that had not seen any use prior to the start of rulemaking. That amendment will have been thirteen years in the making by the time its first stage takes effect in the 1985 model year.

On the whole, the version of centralized decisionmaking which has developed since 1966 has not brought about any major changes in the
design and performance of automobiles. Of course, Congress did not claim in 1966 to be empowering the NHTSA to take over the design functions of private industry. Private decisions still design automobiles. But Congress did confer broad powers on the NHTSA to affect the safety related aspects of vehicle design and performance. Public decisions made since 1966 on the basis of this power have had quite limited impact even on these aspects, however. The safety features found on automobiles made this year coincide closely with ones that could be found on 1968 models.

7.2 Discussion and Conclusions

The initial safety standards forced the adoption of much of the most efficient, most easily integrated safety technology that had been developed by the automobile industry up to that time. These initial standards did not exhaust the state of the art, however, and neither have the subsequent safety standards. The NHTSA's R&D projects, its unfinished rulemakings, and industry R&D show that the state of the art still contains unused technologies. Not all of these technologies are accessible by regulation. Some, like handling and stability improvements, are best put into practice using subjective criteria; the restriction to objective performance requirements makes it very difficult for regulation to force these into use. Others, like the technology represented in the structural modifications made in the Calspan-Chrysler RSV, may be so particular to the different characteristics of individual models that they could be forced into universal use only with exceedingly complex sets of standards.
Of the remaining technologies many could have been forced into use with safety standards. True, it would have required standards development to accomplish this and the NHTSA was occupied for some time in the early 1970s with a few standards to which it gave higher priority, notably passive restraint and braking amendments. One reason that more has not been accomplished by the NHTSA is that it has been given limited resources. But there have been many standards — which would have caused technological change — that the NHTSA has proposed and developed to the point where they assuredly met the constraints of the Safety Act but that the agency has not adopted. There must be many other changes for which standards could have been developed to the same point. Much of what has not been accomplished in the way of technological change in the last ten years was not done not because of the inability of the regulators to develop suitable standards nor because review courts prevented it, but because of deliberate choices not to accomplish it. These choices occasionally have been made by people other than the designated regulators but many of them were made by the latter. Some Administrators may have been chosen for their posts because of accurate expectations about how they would make decisions. This possibility does not change the fact that one reason why more has not been done has been decisions by those who have been given decisionmaking responsibility.

The individual decisions of the officials responsible for regulation have been a limiting factor in the pace with which unused technologies have been forced into use. This is not to say that more regulation would have been better. Indeed, the chronic uncertainty in predictions of the
safety impact and cost of forcing the adoption of unused technologies make it very difficult to confidently say whether each or any of the missing changes would have been socially desirable. Some, for example the set of changes represented by the Experimental Safety Vehicles, were clearly not desirable. Others, like periscope devices, present more difficult decisions. Uncertainty has no doubt made it difficult for regulators to make decisions comfortably; it should also give their critics pause. And, of course, there is the issue of what the criterion of social desirability should be.

Sensible welfare economists long ago abandoned to foolish welfare economists and amateur and professional moral philosophers all speculation about the existence of an objectively valid criterion of social desirability. Normative economic theory claims only that for any inefficient state of affairs there is an efficient one that is preferable. The choice among the possible efficient states must always be made by political processes, either actively or by default to the existing state.

In cases like automobile safety regulation, this kind of political choice translates into the more specific question of how much corporate stockholders and new car buyers will have to pay for risk reductions that benefit a larger group that may include themselves but also many others. The answer to that question determines whether particular standards, the changes in technology they will force, and the resulting cost increases and risk reductions are "desirable"; alternatively, decisions to adopt standards, if made efficiently and consistently, combine to define some implicit answer to that question. One complication in automobile safety
regulation is that in many decisions that must be made, the costs and risks reductions are unknown or uncertain. Thus, political decisions must be made not only on the costs that will be incurred in order to reduce traffic risks — in crude terms, on the value of a human life — but also on how action will be taken in particular instances when ignorance and uncertainty cannot be corrected.

According to accepted constitutional theory, Congress is the proper body for making these decisions. Congress could not and did not make these decisions in 1966. Occasionally it has asserted its authority to make individual regulatory decisions, but it is ill-suited to do this regularly. Instead, Congress has left the decisions to the Secretary of Transportation and through him to the Administrator of the NHTSA. The direction it has given the Administrator and the constraints it imposed on his decisions by providing for judicial review have not been sufficient to determine his decisions for him. The Administrator necessarily formulates original policy when he decides to adopt or reject proposals for standards.

The NHTSA does not like to admit that it is formulating original policy, even though the Safety Act clearly granted it discretion to do so. The NHTSA, and most safety advocates, has tried to maintain the view that Congress set down the guiding policy as the reduction in the "bottom line" of national traffic accident statistics. The NHTSA has always paid attention to costs and to other disadvantages associated with new standards. But it has not admitted that its decisions, if made consistently, correspond to some implicit value of risk reductions. During the period
when cost-benefit analysis has been given a role in the agency's deliberations, the NHTSA has put forward a somewhat inconsistent explanation of the reasons for using it. When the NHTSA estimated the societal costs of traffic accidents, it emphasized that it was not claiming that the estimated cost should be interpreted as implying a correct expenditure for safety standards or a value for human life. But when the NHTSA explains decisions published in the Federal Register in terms of costs that outweigh benefits, it does seem to imply that it has found an objective way to balance the two. If the value individuals place on the risk reductions provided them by a new standard were known, it would still be necessary to make a policy decision on how the uneven distribution of impacts from a decision would be treated. To not consider the distribution important is itself a policy decision. When individuals' values are not known the use of a particular value for human life as a surrogate for them, which the NHTSA's cost-benefit analyses do in fact use, is also a policy decision. Whether the NHTSA uses cost-benefit analysis or whether it considers the reasonableness of cost without quantifying the impacts of a decision, it formulates policy.

The existence of uncertainty in predictions of impacts means that policy decisions must also replace what would ideally have been objective, technical analysis of the consequences of issuing new standards. To accept the use of subjective estimates of effectiveness in formal analyses amounts to the same thing as subjective decisionmaking without formal analyses. Policy judgments are made in both cases. Formal impact analyses may make the lines between objective analysis of impacts, sub-
jective estimates of impacts, and purely policy decisions about the desirability of the impacts more explicit, but they cannot replace policy decisions.

In theory, Congress can legitimately set national policy because of its ties back to the electorate. Congress in turn tied the Administrator to political realities by placing the position in a Cabinet department and making him a political appointee subject to Senate confirmation. By doing so, it left the policy decisions in automobile safety regulation open to political influence exercised through several channels. The play of such influence during the process of regulation is supposed to ensure the quality of its substance, according to some theories of democratic government. The Administrator is not tied very closely to the electorate, however; he is chosen by a Secretary who is chosen by a President, who is in turn chosen by the electorate for reasons other than the correspondence between his and their positions on the set of decisions that will have to be made in automobile safety regulation. As a result, the regulatory process has usually involved only the parties immediately concerned: the NHTSA, the regulated firms, the insurance industry, institutionalized public interest groups, and a few subcommittees of Congress. The process of regulation has been characterized by fundamental conflicts between interests and ideologies, as is the process of most legislation. Uncertainty as to the implications of most decisions has also aggravated the conflict between individuals and groups advocating different decisions. The process has perhaps been more openly quarrelsome for the lack of a stabilizing involvement by a majority of public opinion.
The experience with the last ten years of automobile safety regulation does not mean that decisionmaking that has been collectivized through this type of regulatory structure cannot get anything done. It only means that there must be decisions to get things done and a willingness to do it even when there are doubts about what exactly is being accomplished.

Safety advocates, including some congressmen, like to claim that a political decision made by Congress ten years ago has been preserved in law and that a lack of regulatory aggressiveness on the part of the Administrator borders on subversion of the NHTSA's statutory mandate. This is good polemics but bad theory. What the 1966 victory of the automobile safety advocates established was the regulatory regime; that is preserved in law and gives the advocates of safety a lasting advantage. The regime must rely on present political realities for its decisions on individual proposals, however.

The present political reality seems to be that the majority of the public is not actively demanding more automobile safety regulation. If the vote of the Safety Act were taken now the tally would not be unanimous, as it was in 1966. This does not mean that the regulatory regime cannot accomplish any changes in automobile design and performance. Once in office an Administrator who chooses to do so can accomplish significant changes, as the current passive restraint case will likely demonstrate. Although the public is not demanding more regulation, it will not resist most types of changes. The ignition interlock experience showed that car buyers and users will not immediately accept
some changes which force them to alter the way they use their cars. Their toleration of most other types of changes, even those that raise the prices of new cars, can allow an Administrator to accomplish a good deal.

What the experience with the past ten years of automobile safety regulation does show is that improvements in the process of regulation will be needed if its substance is to be more assuredly beneficial. An Administrator willing to make and defend policy decisions in the face of uncertainty can cause technological change to occur. But he will face the same problems in making good decisions as has each Administrator in the last ten years. The more completely these problems are resolved the more certain it can be that the changes imposed by an Administrator are desirable, by whatever rule of desirability.

7.3 Recommendations

To begin, there are three areas in which improvements are possible but which have been largely outside the scope of this study. First, the NHTSA needs to improve the quality of its accident sampling, investigation, and analysis. These activities are the NHTSA’s only source of information on what problems need to be addressed and on what impact its standards are having on those problems. Second, the NHTSA needs to improve the realism of its performance measures, particularly in crash-worthiness areas. The passive restraint standard will be a conceptual milestone when it takes effect in that it attempts to measure crash-
worthiness in terms of injury production rather than in terms of vehicle mechanics; but the present test dummy is far from a realistic measurement device even for the few injury mechanisms it simulates. Third, the NHTSA needs to rationalize its R&D strategy more than it has. Research support for ongoing rulemaking cannot be neglected, since the quality of new standards depends on it. Since the automobile industry has limited incentives to do exploratory R&D in safety, the NHTSA's involvement in this type of R&D is critically important to the promotion of innovations in safety. The NHTSA must somehow do both types of research, and do them on a budget not adequate for either. But it should avoid allowing R&D projects to claim to serve both needs, but deliver on neither. The success of R&D projects can only be evaluated, and thus potentially improved, if their objectives are clear at their start.

Having given these three areas only enough attention to identify them as problems, it would be inappropriate to offer recommendations on how they should be improved. The problems in all three areas have been realized by the NHTSA and others for some time, and progress in each is being made.

Recommendations will be offered in four other areas:

One

First, the NHTSA should change the entire tone of the regulatory process by being more explicit about what is really being decided in that process. The NHTSA is making policy decisions on the desirability of different combinations of automobile characteristics, just as individual
car buyers do. The difference is that the NTHSA's are public policy choices that affect many people and it therefore considers the interests of persons besides the individual car buyers. The NHTSA for some time now has not been single-mindedly pursuing only reductions in traffic injuries and fatalities. It has been deciding how much in terms of cost and other penalties will be incurred for reductions in traffic risks and traffic losses. The agency should say so.

This does not imply that the NHTSA can or should find some explicit value of human life and make all its decisions on the basis of cost-benefit analyses. It also does not imply an abandonment of any legislated objectives. The NHTSA has obviously been instructed by Congress to place more weight on safety characteristics than does the car buyer-car manufacturer combination. It can still do so while acknowledging that its policy decisions consider the reasonableness of the apparent balance between desirable safety impacts and undesirable cost and inconvenience impacts.

By emphasizing the policy dimensions of the choice between costs and risk reductions, the NHTSA can counteract the claims of both those who see ex post cost-benefit analysis as policy-neutral and therefore the valid decision criterion and those who refuse to admit that cost increases can legitimately be a reason for not adopting a risk-reducing improvement. An Administrator would do better to defend his policy decisions in terms of his legitimate political authority to make them than in terms of a supposedly objective analysis of costs and benefits in a common measure or in terms of constraints in the Safety Act which do not come close to specifying his decision.
Two

The NHTSA should also make clear to its critics, supporters, and the public that it must make decisions without full information on cost and safety impacts, and that this will continue to be necessary even with the improved predictions that may become possible when the NHTSA's new accident sampling and investigation system is in operation. The NHTSA and others should recognize that when it takes action under uncertainty it is doing just that. A false sense of confidence in its estimates does no one good. But the NHTSA should also recognize that it was given its unrestrictive charter in part to allow it to take action even when it was not certain of what it would accomplish by doing so. Congress does the same thing daily. Coping with uncertainty is a policy problem, and should be treated as such, just as should be decisions on how much cost will be incurred for risk reductions. However, if the NHTSA is going to admit that it makes decisions without full information, it must be prepared to continue to acquire information on the accuracy of past estimates and to correct decisions that later appear to have been based on wrong estimates. The fact that decisions will eventually have to be made on the basis of judgment does not mean that informing that judgment with available facts can be neglected. Also, decisions to withdraw standards should not depend on conclusive evidence of their ineffectiveness, any more than decisions to issue standards should depend on absolute proof of effectiveness.
Three

Statistical experimentation with modified automobiles in normal use is an excellent way to improve predictions of both cost and safety impacts. It has seen too little use, however. The NHTSA has used field tests of modified vehicles in a few cases in an attempt to predict safety impacts, but most of the field tests involved too few vehicles under too artificial conditions. The field test with 12,000 General Motors cars with air bags has given the NHTSA the most precise estimate it has ever had for the safety impact of a modification. But even that field test has been insufficient to provide an unimpeachable estimate.

It would be possible to experiment with modifications by adopting a lower threshold of required certainty when issuing new standards. The impacts of the new standards could be evaluated in use, a much easier task than predicting impacts. Decisions to keep or rescind standards could then be made on better information than are decisions to issue new standards now. This approach essentially would experiment with the entire annual production of ten million automobiles. Field tests of this size are both frightfully expensive and unnecessary for predicting impacts, however. What is needed is field testing involving much less than the full annual production but much more that the NHTSA's taxi cab fleet tests, even much more than the field test of the air bag-equipped cars now in use. What is needed is tests involving up to hundreds of thousands of new automobiles. For certain types of changes such fleet testing would allow a very good estimation of safety impact. It also will allow better estimation of production costs. The cost of such an
experiment would be only a few percent of that of experiments involving the entire annual production.

This approach would work best with changes that could be easily integrated into the rest of an automobile. This would allow modified versions of each model to be produced and sold; the unmodified versions of each model would be an excellent control. The air bag was such an easily integrated change. Enlargement of direct or indirect field of view would not be as the entire body of a car might have to be modified. Changes like these would have to be limited to all cars in at most one or two model lines. The information that could be gained from such an experiment would be more limited but still useful. Periscopes, new signaling systems, and automatic braking would perhaps be good candidates. Three-beam and polarized headlamps would not be; they could be evaluated only by converting all automobiles in an isolated population.

Large-scale field testing also can give car users an opportunity to familiarize themselves with a change they might not accept all at once. The NHTSA has put modified vehicles into regular use in government fleets on occasion in order to observe user reactions. One objective of a much larger demonstration would be to personally acquaint enough of the public with a change to actually create a widespread acceptance of the change should the NHTSA later decide to make it universal. For features like air bags, which operate only in rare accident situations, large-scale field testing can give statistical information but can give only a few individuals first-hand experience with the operation of new features. But for accident avoidance features like periscopes or automatic braking,
public exposure can be much broader for the same number of modified vehicles.

The strategy of in-use experimentation is similar to that frequently used by the manufacturers themselves when they introduce a new feature in limited quantities. The type of information the manufacturers obtain in this way is not very different from what the NHTSA needs to obtain. The advantage it can have in reducing the risks of costly larger mistakes can be appreciated by both the manufacturers and the NHTSA. The NHTSA would do well to use the strategy more often. California has served as a useful field test for new emissions control technology because of the lead it has over the rest of the nation in the stringency of its automobile emissions standards. Present small cars and cars with diesel engines provide some information on what the impacts of fuel economy regulation might be. To date there has been no equivalent in safety regulation.

Under existing law, such field tests are possible only at the expense of the NHTSA's research budget, which at its present level would be consumed by a single test, or only when the government has a very strong bargaining position over the manufacturers. The agreement between former Secretary of Transportation Coleman and several manufacturers for a passive restraint demonstration involving half a million automobiles was essentially for a field test of the sort recommended here. The terms of that agreement would have been expensive for the manufacturers. They agreed to it only because of Coleman's upper hand; he had made it clear that only his and later Secretaries' decisions stood between the manufac-
turers and a passive restraint standard. The manufacturers should have been eager for the opportunity to put the field test as well in between them and the standard. The air bag case was special because the NHTSA already had all the information it wanted or felt it needed to promulgate the standard and therefore could present a credible threat. Such situations will be rare. But once the NHTSA has in place an accident sampling and analysis system that can evaluate such changes, it should give consideration to attempting more Coleman-like agreements with the manufacturers for changes for which they would be appropriate.

Congress, on its part, should give consideration to two possible ways of giving the NHTSA legal authority to force manufacturers to cooperate in field tests when it is unable to negotiate voluntary agreements with them. One way would be to allow the NHTSA to force manufacturers to make a certain fraction of their production and sales to special performance specifications. The other way would be to require manufacturers to offer particular safety features as options. The first approach is not unlike present regulation of sales-weighted average fuel economy. Manufacturers might have to subsidize sales of special vehicles to compensate for higher manufacturing cost, since buyers may not be willing to pay for the special features. A version of the second approach was one of the proposed alternatives rejected by former Secretary Coleman in favor of the voluntary demonstration plan. The special advantage of the second approach is that it allows car buyers who want to buy the safety option to do so, something they have not been able to do very often. Assuming that enough do, there will be enough modified vehicles

176
produced and sold to allow field testing. The very special disadvantage of the second approach is that the government would have to ensure that the price of an optional safety feature that is part of an experiment is kept low enough to promote sales, perhaps even below marginal or average cost. The government has never before attempted to control automobile pricing policy in such detail before. There is the additional problem that manufacturers and dealers can easily make it impossible for a car buyer to insist on an option that they prefer not to sell. Clearly, both of these possible approaches need considerable refinement and analysis before a scheme can be developed which ensures that its goals are met in a relatively undisruptive and equitable fashion.

The NHTSA now has the authority to set different specifications for different types of automobiles, but only if "appropriate". A review court would likely find inappropriate a distinction that was made solely to allow in-use experimentation. In addition, the NHTSA presently cannot force a manufacturer to produce any type of car; it can only restrict the production of nonconforming types. A change to allow the NHTSA to write standards for part of a manufacturer's production would thus be a significant departure from past practice, but a useful one.

An alternative would be for Congress to pay the extra costs to the manufacturers of such large fields tests. Compared to the social cost of traffic accidents, such an expenditure could easily be as good an investment as expenditures on energy or health research. Given the NHTSA's experiences with its substantive and appropriations committees, it is more likely to get favorable changes made in the Safety Act to
increase its authority than changes in its budget to greatly increase its funds for field testing.

Four

The NHTSA should go public in ways it has tried to avoid for the past several years. For many years now, the NHTSA has not told outsiders what it was planning or why it has made its decisions the way it has. Unlike some other regulatory agencies, the NHTSA does not publish support papers for its decisions. One reason is that while the agency was maintaining an image of objective and impartial executor of the congressional will, it could hardly afford to release the incomplete information on which it was actually making its decisions. And in periods when the Administrators of the NHTSA were simply not taking new initiatives or completing old ones because of their own policy choices, it was most comfortable for them if others could not observe the choices made and the basis for them. If the NHTSA is going to make political decisions it must provide to the public the information they need to monitor and influence those decisions. Review courts are not allowed to substitute their own policy judgment for that of an agency; the public, in contrast, should be able to do so and they must have information on which to base their positions. Additionally, if the public understands even the limited reasons for the NHTSA's choices, they can better support those choices with which they agree. Delegated authority should be exercised, but those who delegated it should not have to put such blind trust in the delegatees.