Report #22-UO-105

NSTSCE

National Surface Transportation Safety Center for Excellence

Voluntary Versus Mandatory Standards

Analysis of Voluntary and Mandatory Regulations Use Cases to Address Rapidly Developing Technologies

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Submitted: April 20, 2021

Technology
Impairment
Mobility
Infrastructure

Housed at the Virginia Tech Transportation Institute
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ACKNOWLEDGMENTS

The authors of this report would like to acknowledge the support of the stakeholders of the National Surface Transportation Safety Center for Excellence (NSTSCE): Tom Dingus from the Virginia Tech Transportation Institute, John Capp from General Motors Corporation, Terri Hallquist from the Federal Motor Carrier Safety Administration, Chris Hayes from Travelers, Jane Terry from the National Safety Council, and Cathy McGhee from the Virginia Department of Transportation and the Virginia Transportation Research Council.

The NSTSCE stakeholders have jointly funded this research for the purpose of developing and disseminating advanced transportation safety techniques and innovations.

ABSTRACT

This report examines the approaches that are being used by a variety of institutions to regulate rapidly emerging technologies in transportation. Several case studies were examined to determine if there are relevant criteria and situational contexts that determine an agency's choice of either voluntary standards (industry self-regulation) or governmental rulemaking. From this case study analysis, the research team identified the following:

- "Voluntary" and "mandatory" models of rulemaking are not binary choices; rather they are different points along a continuum.
- The federal government, including the Department of Transportation, have developed regulatory tools that rely on both voluntary and mandatory approaches to accommodate innovation.
- Alternative approaches of rulemaking utilized by other agencies, such as a cooperative mixed-model, may be useful for future regulation of automated vehicles.

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LIST OF ABBREVIATIONS AND SYMBOLS

ADS	automated driving system
AEB	automatic emergency braking
ANPRM	Advanced Notice of Proposed Rulemaking
APA	Administrative Procedure Act
ASTM	American Society for Testing and Materials
AVSC	Automated Vehicle Safety Consortium
CFR	Code of Federal Regulations
EPIC	Electronic Privacy Information Center
ESC	electronic stability control
FAA	Federal Aviation Administration
FMCSA	Federal Motor Carrier Safety Administration
FMVSS	Federal Motor Vehicle Safety Standard
FRA	Federal Railroad Administration
GM	General Motors
IIHS	Insurance Institute for Highway Safety
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
MMUC	Model Minimum Uniform Crash Criteria
NCAP	New Car Assessment Program
NHTSA	National Highway Traffic Safety Administration
NPRM	Notice of Proposed Rulemaking
NTSB	National Transportation Safety Board
OEM	original equipment manufacturer
PHMSA	Pipeline and Hazardous Materials Safety Administration
RSAC	Railroad Safety Advisory Committee
SAE	Society of Automotive Engineers
SDO	standard development organization
UNECE	United Nations Economic Commission for Europe
U.S.C.	United States Code
V2V	vehicle-to-vehicle

CHAPTER 1. INTRODUCTION

Over the past 25 years, the Department of Transportation (DOT), including the National Highway Traffic Safety Administration (NHTSA), has traditionally used an administrative rulemaking approach, where the agency issues binding, enforceable regulations. The automotive industry, on the other hand, has often relied on self-regulation via voluntary standards to develop non-binding, unenforceable guidelines or standard practices reached through a consensus of industry stakeholder partners. Today's world presents unique challenges for both of these practices in terms of being able to quickly and effectively regulate rapidly developing technologies, such as vehicles equipped with automated driving systems (ADSs), and their deployment.

Voluntary standards can play an important role in addressing the need for timely standards, but formal rulemaking also has an important role in mandating requirements that industry may have not yet adopted in the interest of public transportation safety. The purpose of this research is to explore reasons why industry self-regulation is sometimes used (and/or used successfully) and why other times formal rulemaking may be necessary. Furthermore, this project explores whether certain criteria or circumstantial characteristics may merit the use of one approach over the other, or be combined if necessary. This project identifies characteristics through a review of case studies of voluntary and government-initiated regulations in the area of emerging technologies.

REGULATORY APPROACHES

The efforts discussed within this report comprise a spectrum of approaches, as shown by the examples in Figure 1, ranging from voluntary industry self-regulation to administrative guidelines to rulemaking efforts.

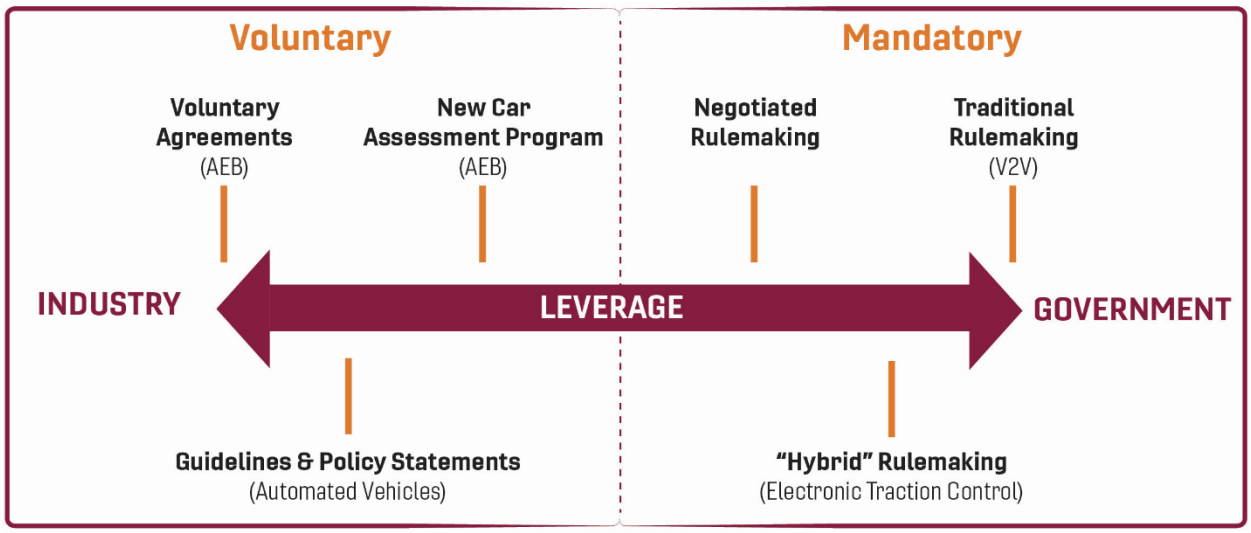

Figure 1. Diagram. Spectrum of regulatory approaches.

At one end of the rulemaking spectrum, industries voluntarily reach a consensus to establish industry-wide acceptance of informal standards or guidelines, often structured through standard

development organizations (SDOs). At this end of the spectrum, the involvement of federal agencies can range from none to active collaboration. At the opposite end of the rulemaking spectrum are types of formal and informal rulemaking, where an agency mandates requirements that, for various reasons, the industry has not adopted widely. In the middle of this spectrum is a mixed cooperative approach in which industry first develops and deploys technologies and/or industry standards that an agency subsequently incorporates into a formal rulemaking. Although it is commonly believed that voluntary and rulemaking approaches are distinct, mutually exclusive options, the findings from this research suggest that a mixed cooperative approach can emerge in certain cases. Although NHTSA has not yet applied mixed cooperative rulemaking specifically in the context of rapidly developing technology, it is discussed within this report because the model is fully applicable to addressing future rulemaking of highly innovative fields in transportation safety.

METHODOLOGY AND SCOPE

This project took a three-step approach to determine if there are relevant criteria and situational contexts that determine the use of either a voluntary standards (industry self-regulation) approach or a governmental rulemaking approach. The first step in this project was to conduct a literature review to define administrative law and rulemaking as well as self-regulation in the automotive industry. The second step used these definitions to identify relevant case studies for selection. For the third step, the literature review was used to aid the research team in understanding the considerations and challenges surrounding each form of rulemaking to apply to the final analysis of the selected case studies.

The following criteria were used to narrow the list of governmental agencies to fit the scope and purpose of this project.

Inclusion Criteria: Federal agencies (1) whose jurisdiction involves transportation, (2) that have recently issued regulations/guidance/policy concerning high-tech subject matter, and (3) who have used non-traditional (i.e., voluntary standards, guidelines, and mandatory rules developed in close collaboration with industry) approaches to the traditional mandatory rulemaking process. The primary source used to identify qualifying agencies was the *Federal Register*, which is the federal government's official source of agency rules, public notices, and policy/guidance related to various issues. The *Federal Register* provides the most comprehensive compilation of agencies' reasoning to support their rulemaking (both traditional and non-traditional) processes.

Exclusion Criteria: Agencies that met the inclusion criteria but have not (1) provided detailed reasoning to support their use of non-traditional rulemaking processes, (2) used non-traditional rulemaking on a consistent basis, or (3) used non-traditional processes in the previous 5 years.

The research team first examined individual agencies of the DOT (e.g., NHTSA, Federal Aviation Administration, Federal Motor Carrier Safety Administration) as a starting point. This resulted in the formation of the above criteria, which narrowed the analytical scope of governmental administrative actions to primarily focus on case studies from NHTSA, the authoritative rulemaker of the automotive industry. Additional agencies, such as the Department of Energy and Federal Trade Commission, were also examined for instances of rapid technology deployment, but were determined out of scope as they did not meet both criteria of rapid

technology deployment and affecting transportation safety. Based on this review, this project seeks to provide a wide range of case studies to identify the circumstances and logic behind regulatory decisions and then determine how regulatory entities interact as a whole. To identify alternate approaches in transportation safety outside the automotive industry, Chapter 5 includes relevant lessons from the Federal Railroad Administration (FRA) and the Pipeline and Hazardous Materials Safety Administration (PHMSA).

The *Federal Register*, where NHTSA publishes final rules, was the primary source used for governmental rulemaking case studies. Westlaw provided a comprehensive review of legal journals to identify historical interactions between voluntary/mandatory regulations and innovation. Publications by the Model Minimum Uniform Crash Criteria (MMUCC), SAE Consortium, National Transportation Safety Board (10 Most Wanted List of Transportation Safety Improvements), and the Alliance of Automobile Manufacturers (i.e., the Auto Alliance, now the Alliance of Automotive Innovation or Auto Innovators) were also examined in this analysis.

Voluntary standards case studies were primarily identified through the literature review as SDOs, organizations that publish agreed-upon codes of practice at the industry level among stakeholders (the most well known of which are SAE, ISO, IEEE, and IEC that work alongside industry efforts). The Automated Vehicle Safety Consortium (AVSC) in particular included a variety of these actors and is discussed in subsequent chapters.

REPORT OUTLINE

The remaining sections of this report are as follows:

Chapter 2, Background, provides a review of administrative rulemaking and an overview of industry self-regulation and associated SDOs.

Chapter 3, Non-regulatory NHTSA Efforts, examines three non-regulatory efforts undertaken by NHTSA:

- 2013-16 Guidelines Regarding Distracted Driving
- 2016 Agreement and New Car Assessment Program (NCAP) Update Regarding Automatic Emergency Braking (AEB)
- 2016-21 Guidance for Automated Vehicles

Chapter 4, Regulatory NHTSA Efforts, reviews six formal rulemaking efforts undertaken by NHTSA:

- Negotiated Rulemaking: 1997 Final Rule for Federal Motor Vehicle Safety Standard (FMVSS) No. 108 (Lamps, Reflective Devices, and Associated Equipment)
- Negotiated Rulemaking: 2006 Final Rule for Multi-Stage Vehicle Certification
- Hybrid Model/Cooperative Rulemaking: 2007 Rulemaking for FMVSS No. 214 (Side Impact Protection)
- Hybrid Model/Cooperative Rulemaking: 2007 Rulemaking for FMVSS No. 126 (Electronic Stability Control)
- Traditional Rulemaking: 2017 Rulemaking for Vehicle-to-Vehicle (V2V) Communications

Chapter 5, Agency-specific Consensus Rulemaking, explores an additional case study drawn from the FRA which presents an agency-specific process known as casual rulemaking to address emerging technologies.

Chapter 6, Conclusions, offers concluding thoughts regarding the appropriate use of the different types of rulemaking and regulations to rapid innovation and technological development in the automotive field.

CHAPTER 2. BACKGROUND

ADMINISTRATIVE LAW AND RULEMAKING

Administrative law expert Philip J. Cooper offers the following definition of public administrative law: "…that which includes the exercise of, and limitations upon, regulatory power all conducted by administrative agencies onto law of civil service, acquisition and management of governmental property, and public works…" (Cooper, 2000, p. 5). This field of law involves a variety of political systems and practitioners, such as the administrative justice system, lawyers, public administrators, benefit claimants, regulated groups, courts, and legislators.

The Administrative Procedure Act (APA; Pub. L. 79-404, 60 Stat. 237) is a statutory framework that governs administrative practice in federal agencies and was established in 1946 to ensure uniformity in agency operations. Two important amendments were made to the APA in Title 5 of the United States Code (U.S.C.) in 1974. The first amendment, the addition of §552(3) to 5 U.S.C. §551, cleared up ambiguities around the definition of an agency to include "any executive department or military department, Government corporation, Government controlled corporation, or other establishment in the executive branch of the Government (including the Executive Office of the President), or any other regulatory agency" (Cooper, 2000, p. 136). The second, the addition of the Fair Information Practices, was a set of rules developed over a 30-year period, that includes, for example, the Freedom of Information Act and Federal Register Act. These practices are important when discussing public participation in the rulemaking process. It is important to note that the APA is not considered a constitution for administrative law, but rather a collection of sections and provisions as one statute within the U.S.C. (Cooper, 2000).

For the purposes of this project, the review of administrative actions has been narrowed to NHTSA. The discussion of the various forms of public administrative law by this agency and its corresponding interactions with other players in the field (e.g., original equipment manufacturers [OEMs], the general public) help to identify the appropriate context in which certain types of rulemaking occur and their consequent results.

Relevant Definitions

The APA defines rulemaking as the "agency process for formulating, amending, or repealing a rule." Furthermore, it defines three types of rules: substantive or legislative rules, procedural rules, and interpretive rules (defined in Table 1). Though all three types of rules have been administered both internally and externally at NHTSA, for the purposes of this project, this report will primarily focus on substantive/legislative rules.

Table 1. Types of rules established by the APA (summarizing Cooper, 2000, p.144).

Rule Type	Description
Substantive/Legislative	Rules that implement or prescribe law or policy (e.g., safety requirements)
Procedural	Rules that describe the organization, procedure, or practice requirements of an agency (e.g., authorization levels, rulemaking committee formation)
Interpretive	Exempted from the rulemaking process, these rules are explanatory statements to provide guidance on an existing law and do not add to or subtract from an existing body of law (e.g., NHTSA's interpretation letter to Google, February 4, 2016; NHTSA, 2016a)

Types of rulemaking can be similarly grouped into five categories (Table 2). Note that this list is not exhaustive. For the scope of this project, we will not be examining the "emergency rulemaking" type, as it exempts agencies from APA procedures and no relevant examples within the project scope were identified.

Table 2. Types of administrative rulemaking (summarizing Cooper, 2000, pp. 147-168).

Rulemaking Type	Description
Informal	Governed by §553 of the APA, this style of rulemaking is a standardized process that uses a "notice and comment" approach to gathering public opinion through the publication of a Notice of Proposed Rulemaking (NPRM).
Formal	Governed by §556 and §557 of the APA, this style of rulemaking requires a formal hearing that mimics a court proceeding structure.
Hybrid	Governed by the requirements of an agency's enabling act or executive order in the case of executive branches, this type of rulemaking is a compromise of formal and informal processes where agencies informally debate complex scientific and technological issues to then publish a formal rule.
Negotiated	Governed by §553 of the APA and the Federal Advisory Committee Act, the agency and solicited stakeholders participate in an in-person session(s) (location and time made publicly available) to analyze knowledge, generate opinions, and negotiate. Once a consensus has been reached that matches both parties' interests, an NPRM is issued to begin the comment process, and to then potentially form a final rule.
Emergency Rulemaking	Exempt from APA procedures by §553 (b)(B), this type of rulemaking occurs "when the agency for good cause finds (and issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest."

Informal rulemaking excludes military and foreign government affairs, as well as items such as public property, loans, or contracts. The key component of this type of rulemaking is the

publication of an NPRM into the *Federal Register* in order to gather public feedback that allows comments to be received in a defined time period. NPRMs must follow the requirements listed in Table 3 as stated in 5 U.S.C. §553 (b)(1),(2),(3).

Table 3. NPRM requirements (5 U.S.C. §553 (b)(1),(2),(3)).

Requirement	Description
1	A statement of the time, place, and nature of public rulemaking proceedings
2	Reference to the legal authority under which the rule is proposed
3	Either the terms or substance of the proposed rule or a description of the subjects and issues involved

Within an NPRM, an agency may issue several policy statements as to the rules they are proposing. These policy statements are not legally binding and do not impose any rights or obligations onto individuals in the present day that they are issued. As such, it would not apply to follow the standard APA procedures to these individuals until the NPRM is issued as a final rule in the *Federal Register*, which must be published 30 days before its effective data (Cooper, 2000, p. 150).

Formal rulemaking, a formal trial-type hearing and judicial process, is only used in a handful of federal administrative law statutes. It is most applied by the U.S. Food and Drug Administration to high-risk cases, such as approval of new drugs or medical devices, and is not necessarily applicable for an executive agency like NHTSA. An administrative law judge or members of the regulatory commission serve as the leader, following similar requirements to a civil trial. Following the trial, the evidenced gathered and a preliminary opinion are issued by the administrative law judge to members of the commission (or secretary of a single-head cabinet department) for a final decision by the policymaker. The publication of a final rule requires justification and substantial evidence to support the reasoning behind the decision (Cooper, 2000, pp. 151-53).

Hybrid rulemaking is a mix of the two preceding rulemaking processes. Hybrid rulemaking primarily emerged in the 1960s and 1970s due to the increasing legal complexity surrounding technological changes. Administrators began to recognize the need to engage scientists and experts in the rulemaking process in order to make the most informed decision. The hybrid rulemaking process is still governed by the APA and requires adherence to a judicial review of agency action, found in 5 U.S.C. §706(2)(A), which ensures that there are no violations of constitutional provisions, that agency authority was lawfully executed, and that the agency was not acting in a way that, as 5 U.S.C. §706(2)(A) states, is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law" (Cooper, 2000, p. 156). What we will refer to as "cooperative rulemaking" could arguably be included under this umbrella. Cooperative rulemaking is where an agency may follow the same model of hybrid rulemaking in a formal way to publish a regulation, but the discussions with scientists and experts have been ongoing for years as the agency informally provides input to voluntary standards and commitments made by industry, which may later be incorporated into a final rule.

Negotiated rulemaking, encouraged by President Clinton through the Negotiated Rulemaking Act of 1990, allows for more interaction between an agency and the stakeholders involved, should a final rule be issued. A facilitator is selected to form a negotiated rulemaking committee of relevant stakeholders, and then the means by which this committee was selected are published in the *Federal Register*. Generally, this committee does not exceed 25 members in order to facilitate focused and effective negotiation. A second consultant may be brought on to facilitate. After a consensus is reached, though the agency is not bound by the outcome of this session, it must follow the NPRM process of a formal publication for public comment (Cooper, 2000, pp. 158-63).

Considerations and Challenges Associated with Each Rulemaking Processes

The rulemaking approaches described in the previous section are not without additional considerations and challenges in terms of the contextual legal approaches. This section discusses those considerations and challenges for all of the rulemaking approaches.

Informal Rulemaking

Informal rulemaking can be well-informed and inclusive. It allows for the participation of the general public in the form of an NPRM. Coglianese et al. (2009) strongly support the use of public transparency, inclusion, and participation in the rulemaking process. They argue that including the public in the informal rulemaking process can potentially result in increased compliance and less opposition at the time of implementation. This process creates communication between administrators, stakeholders, and the public, which can then foster accountability as parties are better able to understand the logic used to develop the final rule. Further, rulemakers can better understand and prepare for the potential impacts of a policy on a population or group (Coglianese et al., 2009, pp. 924-972)

On the other hand, allowing for broad public input increases the administrative burden needed to review the comments and to incorporate feedback into the final rule. As such, this process may not be conducive for a type of rulemaking that needs timely publication, or for rapidly developing technology that needs testing and expert safety guidance.

Policy statements, which are a common practice in informal rulemaking, are generalized, vague, and non-binding. However, policy statements can result in the evasion of APA requirements, and thus courts seek to discourage them, both by maintaining a clear definition of rule types and by denial of exemptions (Cooper, 2000).

Table 4 provides a summary of the key considerations and challenges associated with informal rulemaking.

Table 4. Informal rulemaking considerations and challenges.

Consideration	Challenge
Expands the knowledge capacity of an agency to better inform rulemaking	Generalized, non-binding policy statements can be viewed as evading APA requirements
Encourages participation of actors not represented in other forms of rulemaking	Time-consuming review of comments may not allow for timely rulemaking
Stronger communication and accountability between the agency, stakeholders, and public	May not be suitable to rulemaking needed for rapidly developing technology (e.g., market failure of V2V technology)

Formal Rulemaking

Formal rulemaking consists of an extensive process that is arguably the most thorough and detailed of all four types of rulemaking. Its formality allows for the full documentation and justification of the regulation development process. The resulting documentation and justification can be helpful for reference in future rulemaking efforts. Should there be a need to modify the regulation, then the logic used in the development of the initial regulation has been well tracked. Formal rulemaking also allows for the participation of interested groups as all evidenced is examined in a hearing.

However, because the formal rulemaking process is so detailed and thorough, this process can result in extensive delays, in some cases lasting up to decades. When used in areas involving technology development and innovation, this delay may be harmful to society (e.g., a delay in life-saving medication or vehicle safety features) (Cooper, 2000).

Table 5 outlines the key considerations and challenges surrounding formal rulemaking.

Table 5. Formal rulemaking considerations and challenges.

Consideration	Challenge
Facts and evidence are clearly presented and incorporated	Judicialized decision process not suitable to agency policymaking
Ensures accountability by documenting agencies' use of power	Costly, time-consuming, and potentially burdensome to an administrator
Allows for multiple agencies to work together on complex issues	Not conducive to rapidly developing technology

Hybrid Rulemaking

A more frequently used method of rulemaking today, hybrid rulemaking has become well favored among policy workers. According to Cooper, Judge Bazelon, a justice on the appeals court for the Vermont Yankee Nuclear Power Corp. v. NRDC (1978) case, was instrumental in the development of the hybrid process. Judge Bazelon's comments regarding this process are summarized in Table 6 below.

Table 6. Benefits of hybrid rulemaking (Cooper, 2000, p. 154, Citing Bazelon).

Area of Benefit	Description
Judicial Review	A judge is able to understand what was considered and how it was considered
Peer Review	All materials are available so that the professional scientific and research and community can view records and adequately respond to it
Legislative Oversight	Enables lessons learned from agency performance to be recorded
Public Opinion	Allows for an "adhesive" force in accountability for full disclosure to public
Policy Reconsideration	Value changes or technological advancements over time may cause a reconsideration of policy, which emphasizes the importance of providing clear bases for decisions for future evaluation

Cooper (2000, pp. 154-55) also cites Gellhorn and Bruff (1976), who argue that hybrid rulemaking "…foster[s] reasoned agency decision making by exposing thinking within the agency to public criticism" and emphasizes the need for "…fair treatment of persons submitting comments by requiring actual agency consideration and response…." Hybrid rulemaking also provides an opportunity for public accountability, as Judge Bazelon noted, which is similar to the opportunity afforded through informal rulemaking when an NPRM and request for comments is made.

However, as opposed to informal rulemaking, in a hybrid rulemaking form, comments from a variety of stakeholder types may not be fully incorporated. An agency risks biasing their stakeholder groups by representing only industry. With a disproportional representation of mostly industry stakeholder groups, industry may have an upper hand in expressing their preferences. This may result in an overemphasis on regulations that foster market profit rather than fully informed public safety decisions from a variety of stakeholders.

Walker (2014) examines the relationship between industry self-regulation and vehicle innovation and design for heavy vehicles. Walker suggests that hybrid rulemaking is almost a form of self-regulation being adopted into law: "An outcome of this pressure has been the emergence of more engaged approaches where the state and industry work together to develop flexible and responsive approaches to the policy interests of government and the business objectives of industry. In practical terms this has meant increasing use of compliance approaches that in some form or another draw on industry self-regulation" (Walker, 2014, p. 4). Thus, Walker notes that a delicate balance exists between the view that government should be the ultimate authority of public transportation safety and the view that practitioner expertise provides better insight. Hybrid rulemaking can provide an opportunity to combine knowledge between industry and government to develop more informed regulations. This form of rulemaking could also provide a better response to changing industry needs (Walker, 2014, p. 9).

Table 7 summarizes the key considerations and challenges associated with hybrid rulemaking.

Table 7. Hybrid rulemaking considerations and challenges.

Consideration	Challenge
Expands knowledge capacity of agency to better inform rulemaking	May be biased towards industry preference over public safety
Regulations can be finalized in a shorter period of time	Codifies what industry is accomplishing without much new advancement or information
Industry can express individualized exemptions needed	

Negotiated Rulemaking

Attorney Philip J. Harter (2000), a well-known advocate of negotiated rulemaking, offers criteria to guide an agency's decision to engage in negotiated rulemaking:

- Limited number of interests exist that can be organized sufficiently and adequately represented
- Issues have been well explored and the problem clearly identified
- A finite number of issues exist with differential values on the issues adequately represented
- Agency must be willing to participate
- Agency must be willing to use proper process without sabotaging through executive power

Though rarely used, negotiated rulemaking has a suitable place and time. It can result in stronger communication between industry and the agency, and may serve as a neutralizing force among industry competitors in working towards a common cause to accomplish a positive outcome for the whole industry.

The downsides of negotiated rulemaking are that adequate representation can be subjective and ill-defined. In addition, because of time and funding constraints, it may favor U.S. expertise and organizations that are well-represented in the capital (Cooper, 2000). Coglianese et al. (2009) further this argument:

> Agency officials too often hear mainly from politically popular or well-organized interests, which may make up only a subset of the overall interests that will be affected by many regulatory decisions. In this way, failure to hear from all interests can detract from both the substantive and procedural goals of rulemaking. (p. 938)

Table 8 presents the key considerations and challenges associated with negotiated rulemaking.

Table 8. Negotiated rulemaking considerations and challenges.

Consideration	Challenge
Major stakeholder interests are heard	Consensus may not be reached, or reached quickly
Enforces a sense of shared interest and neutrality among industry competitors	Agency has ability to use power to remove opinions and skew representation
Useful in contentious issues	Committee can be biased to well-established political interests and may not adequately represent all interests

VOLUNTARY STANDARDS AND INDUSTRY SELF-REGULATION

Similarly to Cooper (2000), Gunningham and Rees (1997) argue that there is no single, widely accepted definition for self-regulation within industry. Self-regulation can occur among a variety of actors in a variety of industries. There is a level of consensus among those within the industry to a point of developing agreed-upon guidelines. Rather than give a definition, Gunningham and Rees explore important distinctions of self-regulation from the traditional regulatory space of government. The first distinction is between individual self-regulation and group self-regulation. Both rely on normative orders but differ in whether one institution or several institutions are party. Secondly, Gunningham and Rees suggest that industry self-regulation can be more clearly defined as a "regulatory process whereby an industry-level (as opposed to a governmental or firm-level) organization sets rules and standards (codes of practice) relating to the conduct of firms in the industry" (pp. 364-65). This type of industry-level organization is often referred to as an SDO, the most dominant in the automotive industry being SAE International.

Notably, the United States is unique globally in that it is the only country that uses a voluntary standards system with SDOs. Caroline Cochran, of SAE International, believes that the development of voluntary standards helps to better the industry by improving the relationship between supplier-manufacturers, simplifying the manufacturing process, and expanding market penetration (Cochran, 2005).

Gunningham and Rees also point out that a pure form of industry self-regulation is rare (1997, pp. 363-414). Self-regulation thus can be differentiated by the level of governmental involvement, as shown in Table 9.

Table 9. Types of industry self-regulation (summarizing Gunningham & Rees, 1997, p. 365).

Types of Industry Self-Regulation	
Voluntary Self-Regulation	A form of rulemaking and enforcement conducted by industry that is independent of direct government involvement
Mandated Full Self-Regulation	Sanctioned and monitored by the government, this form of industry rulemaking is developed and conducted by industry, with some government oversight
Mandated Partial Self-Regulation	Rulemaking and enforcement are carried out separately either by industry or government, but both functions are not limited to one entity as they both enforce both publicly and privately written rules

As mandated partial self-regulation implies, there can be a continuum of governmental involvement. Gunningham and Rees believe from several case studies that when there is some level of governmental intervention, self-regulation tends to be more effective than pure self-regulation conducted in isolation to industry only. However, due to the different social, economic, and technological contexts of industry self-regulation, it is potentially inaccurate to make these types of generalizations, and some case studies merit more or less governmental intervention than others (Gunningham and Rees, 1997).

Critics of industry self-regulation have argued against the use of industry self-regulation altogether, as it is an unmonitored process and can deceive the public into entrusting those with economic interests rather than true interest in public safety. “Short-termism” is a term these critics often use to describe industry self-regulation as serving only one purpose: short-term results for economic gratification. Cochran provides an interesting counterargument: that public safety and economic interests can work in harmony if we use the following parallel: Social benefits can be viewed as a spectrum of risk reduction, which in turn can allow the cost-effectiveness of a regulation to be analyzed as the number of statistical lives saved, making what is often abstract transportation policy more concrete. In this sense, public safety can use the same assessment of cost-effectiveness analysis ratios as an industry penetrating a market (Cochran, 2005, pp. 2-3).

Industrial morality, a desire as an industry to preserve ethical standards, can also play a key role in ensuring that institutions are not operating out of limited economic interests only. Gunningham and Rees (1997) argue that an unspoken normative framework exists across institutions because they are all created to uphold a special organizational competence. Although a normative framework of enhancing public benefit through increased mobility from transportation technology does not necessarily dictate a set of policies and procedures for industry institutions, it does provide a skeleton of guiding principles for all to abide by in their effort to contribute to society as a group and to maintain a competitive market (Gunningham and Rees, 1997).

Without a market, they cannot accomplish their institutional purpose. Thus, markets can indirectly dictate a level of respect for upholding public safety norms while maintaining

economic interests. This same sort of collective competition that enforces normative obedience can similarly raise a standard of behavior between entities within the market. This view may address critics' concerns that industry self-regulation is cynical and only serves interested parties at the expense of public safety (Gunningham and Rees, 1997).

Table 10 shows the considerations and challenges for industry self-regulation.

Table 10. Industry self-regulation considerations and challenges.

Consideration	Challenge
More timely than formal rulemaking to easily adapt to rapidly developing technological advancements	May prioritize economic interests over public safety
Fosters collaborative relationships resulting in a collective moral normative framework	System is unmonitored and lacks accountability through formal government processes

SDOs

SDOs formally organize and produce collectively agreed upon codes of practice, rules, and standards for an industry. They are primarily member based and depend on the financial support of both industry and members. They are effective at producing fast-tracked, baseline recommended practices to foster the development of technology that may be time sensitive and cannot afford to go through the delay of a formal governmental regulatory process. However, it is important to note that the government-SDO relationship can be generally positive. NHTSA, for example, will often use the expertise from SDO voluntary standards to inform modifications to regulations or to formally put into effect long-practiced and effective industry-developed guidelines (Cochran, 2005).

NHTSA has incorporated voluntary standards by SDOs such as ASTM, CIE, ISO, and SAE into the publication of formal rules in the Federal Motor Vehicle Safety Standards (FMVSS). This is likely due to the fact the U.S. uses a "self-certification" policy for manufacturers, whereas most countries use "type approval." "Type approval" is a process by national authorities used to test final prototypes submitted by the manufacturer to their reviewing committees. "Self-certification" means that manufacturers agree not to offer their products on the market until they can self-demonstrate and confirm that their products conform to NHTSA's safety standards (Cochran, 2005). As long as the end product abides by NHTSA's safety standards, manufacturers are granted a level of independence and flexibility in the approach and design of the products. Voluntary standards thus help to provide an informal guide to testing processes when a formal process guide does not exist.

Society of Automotive Engineers (SAE) International

One of the most important SDOs for self-regulation in the U.S. automobile industry is SAE International. SAE has produced and maintains approximately 8,300 standards through approximately 7,000 members on their standards committees. SAE first emerged in the early 1900s when automotive technology was developing more quickly than policy, resulting in a sudden need for collaboration within industry to design shared solutions to common technical

issues and for patent protection. SAE evolved into an organization that created what they refer to as "consensus-based standards," or what we refer to in this project as "voluntary standards" (https://www.sae.org/about/history). These standards are developed through a Motor Vehicle Council, with seven systems groups and approximately 463 active committees (Cochran, 2005).

SAE has since expanded beyond the automotive industry into other areas of transportation, such as aerospace. It has also crossed borders internationally, which aids in the harmonization of global voluntary standards through the creation of global technical regulations (Cochran, 2005). It has evolved from what they describe on their website as a "… predominantly standards centered organization [in]to a broader-based information exchange organization," which allows for more inclusive participation in the development of standards, similar to the hybrid form of rulemaking in administrative law (https://www.sae.org/about/history).

The AVSC *Best Practice for Metrics and Methods for Assessing Safety Performance of Automated Driving Systems (ADS)* is a great example of this type of collaboration (Automated Vehicle Safety Consortium, 2021). In light of the recent advancements in ADS technologies in the last decade, SAE saw the need establish a technology-neutral set of best practices for future informed rulemaking and the safe deployment of these vehicles on public roads. A consortium was formed under the SAE Industry Technologies Consortia® (SAE ITC) in order to publish best practices specific to automation Levels 4 and 5.

AVSC outlines their goals as follows (p. 3):

- Develop and prioritize a roadmap of pre-competitive topics
- Establish working groups to address each of the topics
- Engage the expertise of external stakeholders
- Share output/information with the global community
- Initially focus on fleet service applications

The establishment of the AVSC is very similar to NHTSA's use of hybrid rulemaking. SAE ITC used AVSC documents as a way to encourage and solicit open comments and discussion on appropriate industry forums from stakeholders to better inform the recommended practices. The development of the AVSC established a consistent foundation to be used across industry as ADS technology develops. Furthermore, other standards, such as ISO 26262-1:2018, ISO PAS 21448:2019, and ISO 8855:2011, and research conducted by NHTSA-sponsored projects were included in these practices. Components of foundational safety are represented in definitions, safety performance metrics, and subsequent safety evaluations. As this is a set of voluntary guidelines, it can be easily adjusted and amended to incorporate new information as testing and deployment develops. This is useful in an era of rapidly developing automated technology, when traditional formal rulemaking may be less flexible and take longer to develop.

CHAPTER 3. NON-REGULATORY NHTSA EFFORTS

This chapter presents three cases where NHTSA chose to pursue non-regulatory approaches in lieu of formal rulemaking:

- 2013-16 Guidelines Regarding Distracted Driving
- 2016 Agreement Regarding AEB and Inclusion in NCAP
- 2016-2021 Guidance for Automated Vehicles

2013-16 GUIDELINES REGARDING DISTRACTED DRIVING

In 2013 and 2016, NHTSA issued voluntary guidelines to address risks posed by in-vehicle and portable electronic devices that require drivers to take their hands off the steering wheel or eyes off the road (Visual-Manual NHTSA Driver Distraction, 2013). NHTSA pursued a voluntary approach after conducting years of research and providing the public ample opportunity to comment. The agency opted for this approach instead of pursuing a rulemaking, in part, because of the rapid pace of technological development with in-vehicle electronic devices.

Safety Need: Concerns from Use of Electronic Devices While Driving

NHTSA was concerned about the effects of driver distraction from the use of electronic devices on motor vehicle safety. The agency defined "driver distraction" as occurring when electronic devices compete for drivers' attention, diverting their focus away from driving to other activities associated with the devices. Electronic devices include both in-vehicle electronic devices (e.g., navigation or infotainment systems) and portable electronic devices (e.g., mobile phones). NHTSA observed that in 2010 distractions from devices (and other sources) caused 17% (or 900,000) of all police-reported crashes, and 3% (26,000) of all police-reported crashes were attributable specifically to use of in-vehicle electronic devices (Visual-Manual NHTSA Driver Distraction, 2013).

Solution: Voluntary Guidelines

At the time the guidelines were issued, technology existed to prevent a driver from using a mobile phone while driving (Halverson, 2013). NHTSA arguably had legal authority to promulgate regulations requiring OEMs to install such disabling devices. However, the agency specifically opted not to do so, choosing instead an incremental, voluntary solution comprised of the issuance of non-binding, non-enforceable guidelines, in three phases. In 2013, NHTSA issued Phase 1, which addressed distractions caused by in-vehicle electronic devices. In 2016, NHTSA published a proposal for Phase 2, which would address distractions caused by portable electronic devices; the final guidelines were published in 2017 (Visual-Manual NHTSA Driver Distraction, 2016). Phase 3 guidelines are pending.

NHTSA drew upon on numerous sources to inform the guidelines. Phase 1 guidelines drew upon industry standards developed by the Alliance of Automobile Manufacturers, data from naturalistic driving studies performed by the Virginia Tech Transportation Institute, and the automobile industry and academic researchers in Europe and Japan (Visual-Manual NHTSA Driver Distraction, 2012).

Rationale

NHTSA articulated a clear rationale for opting to embody its recommendations in guidelines instead of a regulation. The agency set forth three primary reasons (Visual-Manual NHTSA Driver Distraction, 2012):

1) [T]his is an area in which learning continues, and . . . continued research is both necessary and important.

2) [T]echnology is changing rapidly, and a static rule, put in place at this time, may face unforeseen problems and issues as new technologies are developed and introduced.

3) [A]vailable data are not sufficient at this time to permit accurate estimation of the benefits and costs of a mandatory rule in this area. . . . [I]n order to issue a rule, we need a defensible estimate of the magnitude of such benefits and the corresponding costs.

Despite the unenforceable nature of guidelines, the agency noted that monitoring was important. NHTSA stated that it would monitor OEM adoption of the guidelines, either through internal means or via contractors (Visual-Manual NHTSA Driver Distraction, 2016).

Results

A commentary from Yale Law School has criticized the guidelines as "an exuberant celebration of volunteerism," arguing that NHTSA was apprehensive of requiring devices that would prevent drivers from using portable electronic devices, which would significantly intrude upon motorists' freedom (Mashaw and Harfst, 2017, p. 266). Accordingly, the commentators contend that NHTSA believed that the need for public acceptance outweighed the need for motor vehicle safety.

Despite NHTSA's stated intent to monitor industry adoption of the guidelines, as of December 2016, the agency continued to repeat that "the details of this monitoring have yet to be determined" and that "test results would be made available to the public" once they were released. However, NHTSA has yet to release any such results (Visual-Manual NHTSA Driver Distraction, 2016).

2016 AGREEMENT REGARDING AEB AND INCLUSION IN NCAP

NHTSA has leveraged two non-rulemaking tools to hasten industry installation of AEB in light vehicles: a voluntary agreement with automobile OEMs, and the agency's NCAP (New Car Assessment Program; Safety Labeling, 2011). First, and most importantly, in 2016, NHTSA (along with the Insurance Institute for Highway Safety [IIHS]) announced that it had entered into a voluntary agreement with 20 automobile OEMs to install AEB systems. Under the agreement, "Commitment to Advancing Automatic Emergency Braking Technology," OEMs agreed to install AEB as standard equipment in nearly all of their light motor vehicles by the mid-2020s. Second, NHTSA added AEB technologies to NCAP, which the agency uses to incentivize OEMs to install crash protection and crash avoidance technologies that exceed FMVSS requirements.

Safety Need: Injuries and Fatalities from Rear-End Crashes

NHTSA sought to prevent and reduce rear-end vehicle crashes. The agency noted that nearly 1.7 million rear-end accidents occur annually, resulting in 1,000 deaths and 700,000 injuries. NHTSA estimated that AEB could avoid or mitigate 910,000 crashes annually (NCAP, 2015, December 16).

Solution: Voluntary Agreement and NCAP

Under the voluntary agreement, OEMs agreed to install AEB on vehicles with a gross vehicle weight of 8,500 lbs or less by September 2022, and vehicles with a gross vehicle weight of between 8,501 lbs and 10,000 lbs by September 2025. The agreement requires OEMs to submit annual reports on their progress, which are published at www.regulations.gov. In addition, Consumer Reports is independently monitoring OEM progress and also publishing reports. Apart from public reporting requirements, the commitment is not enforceable.

In addition to the agreement, in 2011 NHTSA added forward collision warning to NCAP as a recommended crash avoidance technology as a first step to hasten adoption of more advanced AEB technologies, such as forward collision avoidance. Under NCAP, vehicles are assigned ratings in the form of safety stars based on crashworthiness and rollover resistance, and earn recommendations if they meet the criteria for being equipped with the presence of certain advanced crash avoidance technologies (NCAP, 2011). This program requires vehicles to display a label with their designated star safety ratings as determined by NHTSA through their performance criteria evaluation. NHTSA boasts that NCAP creates consumer demand for improved crashworthiness and crash avoidance technologies, which incentivizes OEMs to voluntarily offer features that they otherwise would not (Federal Motor Vehicle Safety Standards; Automatic Emergency Braking, 2017). The presence of these features would earn OEMs a safety star, a prized rating in the consumer industry. In 2015, NHTSA expanded its use of NCAP by adding additional AEB technologies, crash imminent braking and dynamic brake support (NCAP, 2015, December 16).

Rationale

NHTSA explicitly justified its use of voluntary, non-rulemaking tools by contending that rulemaking would hinder technologies (such as AEB) in nascent stages of development, and require substantially greater implementation time than a voluntary agreement. NHTSA explained,

> [M]any modern vehicle safety technologies are software-controlled and . . . evolving very quickly. Standard setting at this early stage of technological evolution must be undertaken with great care, given the risk of inadvertently stymieing innovation and stalling the development . . . of . . . these technologies. (Federal Motor Vehicle Safety Standards; Automatic Emergency Braking, 2017)

In addition, the agency added that "rulemaking, and the research that must precede it . . . take considerable time, often six to ten years for full implementation," and that "increasing complexity of vehicle safety technologies factors into the lengthening of the Agency's rulemaking proceedings." Implementation time was also an important factor in pursuing a

voluntary agreement. NHTSA explained that rulemaking would result in a substantial delay, requiring "as many as three [additional] years, and possibly longer" (Federal Motor Vehicle Safety Standards; Automatic Emergency Braking, 2017). NHTSA's decision to pursue a non-regulatory approach was not a hasty decision. To the contrary, the agency methodically and diligently researched AEB technologies for 6 years before entering into the agreement. In addition, NHTSA sought public comment on AEB multiple times. Notably, in 2012, NHTSA sought public comment on the results of its research (Advanced Braking Technologies That Rely on Forward-Looking Sensors, 2012). In 2015, NHTSA granted a petition by the safety advocacy groups Truck Safety Coalition, the Center for Auto Safety, Advocates for Highway and Auto Safety, and Road Safe America to initiate rulemaking to mandate the installation of AEB technologies in heavy trucks; that rulemaking is pending (Federal Motor Vehicle Safety Standard; Automatic Emergency Braking, 2015).

Results

Consumer advocacy groups Consumer Watchdog, Center for Auto Safety, and Public Citizen have harshly criticized NHTSA, arguing that the agency abdicated its mission and acquiesced to the industry. Public Citizen argued, "Voluntary standards don't work. They protect manufacturers, not consumers" (Consumer Watchdog, 2016). Consumer Watchdog echoed similar concerns, stating that the voluntary agreement "represents an unenforceable pledge to implement weak versions of the [AEB] systems" (2016). In 2016, these organizations petitioned NHTSA to initiate a mandatory rulemaking for AEB, followed by a lawsuit compelling the agency to rule on the petition. Among other things, the advocacy groups argued that nuances in the agreement would result in a weak system that could not even bring a car to a complete stop from a speed of just 12 mph (Center for Auto Safety, 2016).

Many countries have squarely rejected the voluntary approach and opted instead for mandatory regulation. On February 12, 2019, the United Nations Economic Commission for Europe (UNECE) announced that 40 countries, including the European Union, Japan, Russia, and South Korea, had agreed on a draft United Nations regulation that requires installation of "Advanced Emergency Braking" systems on cars and light commercial vehicles carrying up to eight passengers (Hosokawa, 2019). The UNECE noted that although AEB was already available in cars in some countries, "there [are] no standard technical requirements guaranteeing the effective performance of such systems so far" (2019). The new United Nations regulation will impose strict requirements for the use of AEBs at a range of different speeds, from 0 to 37 mph. The draft regulation was formally voted on in June 2019 (https://unece.org/DAM/trans/doc/2019/wp29grva/GRVA-02-39c1e.pdf). The regulation became effective in early 2020 and requires compliance by 2022.

2016-2021 GUIDANCE FOR AUTOMATED VEHICLES

Safety Need: Injuries and Fatalities from Rear-end Crashes

SAE established a set of consistent definitions for ADS in their *Recommended Practice J3016: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* (2018). From industry and institutional feedback, these definitions have since been revised several times in the last 5 years, with the most recent published in June 2018.

J3016 provides a taxonomy of the levels of driving automation, ranging from Level 0 (no automation) to Level 5 (full automation). These levels are defined by the ability of the automation feature to engage accurately with the dynamic driving task. While NHTSA has not formally incorporated these definitions into rulemaking, they reference this taxonomy often as a guiding principle during rapid technology development.

NHTSA's interest in ADS lies in its potential "to reduce injuries, the loss of life, and property damage, reduce congestion, enhance mobility, and improve productivity for saving lives" (Removing Regulatory Barriers, 2018). NHTSA estimates that 94% of all crashes occur because of human error, and that automated technology can help to address and mitigate the overwhelming majority of such crashes (Request for Comment on "Federal Automated Vehicles Policy," 2016).

The MMUCC crash report template provides new fields for law enforcement to specify a vehicle's ADS capabilities and the driving automation engaged at the time of the crash. It was updated in August 2017 to include NHTSA guidance to law enforcement for SAE definitions and recording ADS data on crash reports—however, this update is voluntary guidance and not a mandatory crash reporting standard (MMUCC, 2017).

Solution: Voluntary Guidance

NHTSA believes its role is to facilitate the safe introduction and deployment of ADS technologies into the market. However, the agency has also noted that "the remarkable speed with which increasingly complex technologies are evolving" was challenging, forcing the agency to "build its expertise and knowledge to keep pace with developments . . . and increase its speed of execution" (Request for Comment on "Federal Automated Vehicles Policy," 2016). Accordingly, NHTSA opted for a voluntary approach to regulation instead of rulemaking.

In 2016, NHTSA inaugurated its foray into ADS regulation by issuing the first of four guidance documents, *Federal Automated Vehicles Policy* (hereinafter "AV 1.0"; NHTSA, 2016b). The document was intended to provide reasonable practices and procedures that the industry should follow in the near term to design, test, and deploy highly automated vehicles (Request for Comment on "Federal Automated Vehicles Policy," 2016). NHTSA intended AV 1.0 to be a living document, evolving over time based on the experience of the industry, public comments, and technological development (Request for Comment on "Federal Automated Vehicles Policy," 2016). While issuance of this guidance was significant in itself, arguably the most important feature of NHTSA's guidance was a revision to its practice of issuing letters of interpretation and exemptions regarding its regulations. Interpretation letters enable persons to ask NHTSA to explain and clarify the meaning of a regulation, statute, or overall legal framework (NHTSA 2016b, pp. 50-54). Exemptions waive compliance obligations with FMVSS in certain circumstances (NHTSA 2016b, pp. 54-55). Historically, NHTSA has used interpretation letters and exemptions to address the introduction of new technologies (Federal Automated Vehicle Policy, 2016b, p. 48). Typically, issuance of interpretation letters and exemptions requires several months to years (NHTSA, 2016b, p. 48). With AV 1.0, however, NHTSA advised that it had expedited its process specifically for ADS technologies and would endeavor to respond to interpretation requests within 60 to 90 days and respond to exemptions within 6 to 12 months—substantially shorter than before (NHTSA, 2016b, pp. 54, 62).

In 2017, NHTSA released a revised version of its guidance, *Automated Driving Systems: A Vision for Safety* (hereinafter "AV 2.0"; NHTSA, 2017). The new guidance incorporated comments submitted in response to the previous guidance document, public meetings, and other sources. The revised guidance proposed safety design elements relating to vehicle cybersecurity, human-machine interfaces, crashworthiness, and post-crash ADS behavior, among other things (NHTSA, 2017). NHTSA stated that the revised guidance was a "cohesive package that represents the Agency's current position on Automated Driving Systems" (NHTSA, 2017). The purpose of the guidance was "to support industry innovators, States and other key stakeholders" in the testing and deployment of automated vehicle technologies" (NHTSA, 2017).

In October 2018, NHTSA published the third version of its voluntary guidance, *Preparing for the Future of Transportation: Automated Vehicles 3.0* (AV 3.0) (NHTSA, 2018). AV 3.0 expanded the scope of AV 2.0 to all surface on-road transportation systems, reduced policy uncertainty, and outlined a process for working with the DOT (NHTSA, 2018). In the announcement of AV 3.0, Secretary of Transportation Elaine Chao noted the importance of voluntary compliance and self-reporting (U.S. Department of Transportation, 2018). She emphasized that ultimately the Department is only interested in determining the safety of automation technology and remained technology neutral—manufacturer suites or packages would be chosen by what suits consumers best. Voluntary compliance and self-reporting help to provide an open conversation without fear of punishment so that the industry can work together to improve safety with consistency in their taxonomy and practices; as the technology continues to develop, these voluntary guidelines can continue to be amended.

AV 4.0 was released in January 2020. This updated version brought together a larger collaboration between a variety of federal and non-federal agencies, including executive offices of the President. The purpose was to provide a clearer stance on the government's position, a more harmonized federal approach, and revealed plans of federal investment in regard to the development and deployment of automated vehicles. It also provided key guidance for industry by including an outline of 10 principles. These principles placed protection of public safety at the forefront while still maintaining the balance of an efficient and competitive market (U.S. Department of Transportation, 2020).

Rationale

NHTSA has consistently supported a non-regulatory mechanism to address ADS. When issuing its first guidance in 2016, NHTSA's rationale was that a voluntary approach, in contrast to a mandatory regulation, would "speed the delivery of an initial regulatory framework and best practices" while "ensur[ing] that premature, static regulatory requirements do not hinder innovation and diffusion of the dynamic technologies that are being developed in the industry" (NHTSA, 2016b).

In releasing revised guidance in 2017, NHTSA stated that "[g]iven the developing state of the technology, this Voluntary Guidance provides a flexible framework for industry to use in choosing how to address a given safety design element." In addition, the agency asserted that it "recognize[d] that regulatory efforts in this arena must promote safety, remove any existing unnecessary barriers, remain technology neutral, and enable a pathway for innovation . . ." (NHTSA, 2017). Importantly, NHTSA also suggested that it was not contemplating new

mandatory regulations in the near term: "[a]ny initiative in the regulatory realm will seek to remove regulatory barriers and burdens that could unnecessarily hinder the safe and efficient implementation of ADSs" (NHTSA, 2017).

The revised guidance in 2020 signifies a more unifying approach, emphasizing the agreement among federal agencies and actors and strongly encouraging collaboration among industry partners to continue to pursue research and development. NHTSA acknowledges that we are still in an evolving stage, and more research needs to be conducted both in pilots and on-road deployments: "[g]iven that ADS are still currently in the R&D phase and not available for consumer purchase, data on collision rates for ADS under real-world conditions are limited at this time and a standardized vocabulary and methodology for evaluating and regulating their safety is still being developed by NHTSA, State regulators, and other stakeholders. However, numerous technologies that are related to ADS, such as automatic emergency braking, lane departure warning, and adaptive cruise control, are already being incorporated into conventional vehicles and their effect on collision rates can be evaluated" (U.S. Department of Transportation, 2020, p. 3).

Results

OEMs generally supported the non-regulatory approach, whereas advocacy groups generally criticized the absence of mandatory regulations as dangerous. The Alliance of Automobile Manufacturers, a trade association that claims to represent 70% of all U.S. car and light truck sales, hailed the approach for "provid[ing] greater clarity to auto manufacturers and technology providers working to develop cutting-edge technologies" (Auto Alliance, 2018). On the other hand, multiple advocacy groups objected. The Electronic Privacy Information Center (EPIC) complained that automated vehicles raise serious issues regarding privacy, cybersecurity, and public safety that warrant mandatory regulations. EPIC stated that NHTSA's voluntary approach fails to address the breadth and severity of safety risks posed by automated vehicles" and "will impede efforts to make automated vehicles safer and more secure" (EPIC, 2018). The Center for Auto Safety harshly condemned NHTSA's approach, stating "DOT's voluntary approach rests on unproven assumptions and is based on strict anti-regulatory ideology and a willingness to completely defer to industry control over public safety" (The Center for Auto Safety, 2018). Similarly, the Advocates for Highway and Auto Safety stated, "Voluntary agreements made between industry groups without public inspection or input are inherently biased and thus, inadequate to ensure the level of protection provided by federal regulations" (Advocates for Highway and Auto Safety, 2018).

Regarding NHTSA's expedited timeline to process exemption petitions for ADS, at least one industry participant has embraced this new policy. On March 19, 2019, NHTSA published a request for public comment on an exemption petition submitted by General Motors (GM) for a driverless electric vehicle equipped with ADS (General Motors, 2019). In the petition, GM is seeking a temporary exemption from 16 FMVSS to enable GM to test and develop a vehicle lacking manual controls, such as steering wheels, gear selectors, and foot pedals. NHTSA acknowledged the significance of this petition, as it is the first petition in the agency's history for such a vehicle. NHTSA stated that "this is an important case of first impression" and anticipates similar petitions in the near term (General Motors, 2019, p. 10183). Although NHTSA denied

this petition in 86 FR 48812 in 2021, NHTSA's expedited exemption policy for ADS demonstrates yet another regulatory tool to address innovative fields (General Motors, 2021).

CHAPTER 4. REGULATORY NHTSA EFFORTS

This chapter discusses the case study performed on regulatory efforts made by NHTSA. It will review six formal rulemaking efforts undertaken by NHTSA to address safety needs and provide solutions.

1997 FINAL RULE TO AMEND FMVSS NO. 108 (HEADLAMPS)

Safety Need: Improperly Aimed Headlights

NHTSA commenced this rulemaking in response to a petition for rulemaking from GM. GM sought an amendment to FMVSS No. 108 (Lamps, Reflective Devices, and Associated Equipment) to enable use of headlamps that could be aimed using a new optical aiming device instead of the incumbent mechanical device. NHTSA granted the petition in order to address safety issues associated with inaccurate headlight aiming. The agency determined that the appropriate solution was development of a headlight beam pattern that provides an objective visual determination of aim accuracy (Lamps, Reflective Devices and Associated Equipment; Establishment of Negotiated Rulemaking Advisory Committee, 1995).

Solution: Negotiated Rulemaking

In developing this regulation, NHTSA adopted, for the first time in its history, a new model of rulemaking known as "negotiated rulemaking." Negotiated rulemaking first emerged in the early 1980s and gained impetus in the early 1990s with the enactment of legislation and White House executive orders. The relevant statute defines "negotiated rulemaking" as a process that involves establishing an advisory committee composed of representatives from the agency and regulated entities. Committee members actively discuss the issue, devise potential solutions, reach consensus, and draft a proposed regulation. Negotiated rulemaking is an inclusive process intended to accelerate rulemaking and maximize the ability to produce a regulation that is acceptable to regulated entities, while minimizing the petitions for reconsideration and litigation. In contrast, although traditional rulemaking also permits solicitation of comments from the public, there is no significant engagement between the agency and stakeholders, and the typical timeframe for producing a regulation is substantially longer (Lamps, Reflective Devices and Associated Equipment; Establishment of Negotiated Rulemaking Advisory Committee, 1995).

Rationale

The relevant statutes advise agencies to consider initiating negotiated rulemaking if a limited universe of identifiable interests exists, those interests can be adequately represented, and a likelihood exists that the interests can reach consensus within a prescribed period. NHTSA believed that the headlamp aimability issue met these criteria and warranted initiation of a negotiated rulemaking process. In addition, the agency noted that certain problems may require a regulatory approach different from traditional rulemaking, and that negotiated rulemaking might facilitate more "effective communication and creative solutions" (Lamps, Reflective Devices and Associated Equipment; Establishment of Negotiated Rulemaking Advisory Committee, 1995).

Results

NHTSA's first foray into negotiated rulemaking was successful in accelerating the rulemaking process and in producing a regulation acceptable to all involved parties. NHTSA established the negotiated rulemaking advisory committee in July 1995 (Lamps, Reflective Devices and Associated Equipment; Advisory Committee Public Meeting, 1995). Just one year later, NHTSA published a proposed rule based on consensus reached by the committee (Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices and Associated Equipment, 1996), followed 7 months later by a final rule (Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices and Associated Equipment, 1997). NHTSA published a final regulation just 21 months after initiating the negotiated rulemaking—significantly shorter than traditional rulemaking. The speed at which negotiated rulemaking led to a final regulation demonstrates that the model was a successful approach. Indeed, NHTSA received no public comments opposing its consideration of the negotiated rulemaking process.

2006 FINAL RULE FOR CERTIFICATION OF VEHICLES BUILT IN MULTIPLE STAGES

Safety Need: Multistage Vehicle Certification with FMVSS

Regulating the ability of manufacturers of multistage vehicles to certify compliance with the FMVSS has been a vexing problem for NHTSA. Multistage vehicles are manufactured in various steps by different manufacturers. The process begins with the manufacture of "incomplete vehicles" (e.g., school buses), which include at least a frame and chassis structure, power train, steering system, suspension system, and braking system. Incomplete vehicles are then completed by intermediate and/or final manufacturers (Meeting With Manufacturers, 1995). NHTSA's regulatory efforts in this area have been subject to multiple lawsuits since the 1970s, all of which the agency lost. In 1991, NHTSA published a proposed regulation that would extend certification requirements to all manufacturers of incomplete vehicles and permit all final stage manufacturers to pass through the certification of incomplete vehicles under certain circumstances. However, the proposed regulation drew significant controversy and had "virtually no support" in the industry, with positions aligned with manufacturers' respective positions in the multistage vehicle industry (Vehicles Built in Two or More Stages, 1999).

Solution: Negotiated Rulemaking

In late 1995, NHTSA considered proceeding with a negotiated rulemaking and sought public comment on this approach (Meeting With Manufacturers, 1995). In response, NHTSA received many comments in support of proceeding with a negotiated rulemaking and no comments criticizing the approach. In 1999, NHTSA established an advisory committee to develop amendments to existing regulations governing multistage vehicle certification.

Rationale

Ostensibly, the lengthy and contentious regulatory history of this area, as well as the push from the White House and Congress, compelled NHTSA to opt for negotiated rulemaking.

Results

After nearly four-and-a-half years, the committee failed to reach consensus on several key issues, forcing the agency to issue a supplemental proposed regulation in 2004. NHTSA published the final regulation in 2006, more than 5 years after convening the first committee meeting, and even drew a petition for reconsideration from one of the committee members, adding more than a year of delay. Under benchmarks for successful negotiated rulemaking established by the White House and NHTSA itself (Meeting With Manufacturers, 1995, and NHTSA's stated objective of avoiding petitions to reconsider), this endeavor produced mixed results. On one hand, the process failed to achieve consensus among stakeholders, required more than 5 years (roughly the same as traditional rulemaking), and drew a petition for reconsideration. However, given the decades-long contentious history of this area, perhaps this result was not surprising. On the other hand, NHTSA explained that despite the failure to reach consensus, the process provided the industry a unique opportunity to engage in developing the regulation and adequately balanced the needs of all committee members.

2007 RULEMAKING FOR FMVSS NO. 214 (SIDE IMPACT PROTECTION)

In 2007, NHTSA published a final rule amending FMVSS No. 214 to, in part, incorporate a dynamic pole crash test. This regulation was prompted by a subsequent congressional mandate requiring NHTSA to conclude a side impact rulemaking in just 3 years, which was significantly shorter than the 6 or more years required for most NHTSA rulemakings (Safe, Accountable, Flexible, Efficient Transportation Equity Act, 2012). The amended regulation required OEMs to improve head and chest protection in side crashes. Indirectly, the regulation would lead to the installation of new technologies, such as side curtain air bags and torso side air bags. Although this is a mandatory regulation, it is effectively an example of what could be called "cooperative regulation," a model in which an agency incorporates an existing standard developed and deployed widely by the industry. Co-regulation of this sort is a mixed approach that blends elements of both voluntary and mandatory rulemaking.

Safety Need: Injuries and Fatalities from Side Impact Collisions

NHTSA sought to reduce injuries and fatalities from side impact collisions. The agency's research noted that in 2004 there were 2,311 fatalities and 5,891 serious injuries for near-side occupants (Federal Motor Vehicle Safety Standards; Occupant Protection, 2007). NHTSA estimated the final rule would prevent 311 fatalities and 361 serious injuries annually (Federal Motor Vehicle Safety Standards; Occupant Protection, 2007).

Solution: Mandatory Regulation Incorporating Existing Industry Voluntary Standards

The final rule largely adopted a voluntary industry-developed standard that was already widely deployed at the time of regulation. In 2003, the Alliance of Automobile Manufacturers and the IIHS announced a voluntary commitment among 15 automobile OEMs to meet new voluntary industry-developed standards that sought to improve occupant protection in front and side crashes. This voluntary commitment essentially equated the "front to front" and "front to side" compatibility in side curtain air bag testing. IIHS explained that the voluntary standard was superior to a mandatory regulation because the voluntary approach offered a faster track than the

federal regulatory process (IIHS, 2004). Signatory OEMs committed to 50% vehicle compliance in 2007 and full compliance by 2009 (Federal Motor Vehicle Safety Standards; Occupant Protection, 2007). NHTSA increased the safety requirements of the testing through its final rule by requiring a dynamic pole test and usage of a different test dummy.

Rationale

NHTSA's final rule adopted and expanded upon the industry standard. The agency boasted that this co-regulatory approach, in which NHTSA followed the lead established by the industry, hastened the pace of technological proliferation and led to enhanced safety compared to a NHTSA-led mandatory regulation:

> Through voluntary efforts, manufacturers are able to begin equipping vehicles with advanced technologies and are able to advance safety more quickly than through the regulatory process. In formulating this regulation, we have been mindful to remain consistent with the technological advances upon which the industry's voluntary commitment were based . . . . Together, the near term voluntary commitment and this final rule will achieve unprecedented side impact protection benefits. (Federal Motor Vehicle Safety Standards; Occupant Protection, 2007)

Results

Academic commentators from Yale Law School have criticized NHTSA's co-regulatory approach to FMVSS 214 as a mere codification of the existing industry practice, contending that the regulation "was not really bringing much to the party" (Mashaw and Harfst, 2017). The commentary further argues that industry was on track to achieving nearly the same result, albeit on a slightly longer timeframe. On the other hand, a dynamic pole test may never have been established and the standardization of a different type of test dummy may have increased safety in a way that would not have emerged under industry voluntary standards.

2007 RULEMAKING FOR FMVSS NO. 126 (ELECTRONIC STABILITY CONTROL)

Prompted by the same congressional mandate that required completion of a side impact rulemaking in just 3 years (Safe, Accountable, Flexible, Efficient Transportation Equity Act, 2005), in 2007 NHTSA promulgated FMVSS No. 126, a new standard that established mandatory requirements for electronic stability control (ESC; Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007). This standard required OEMs to install equipment to automatically provide braking of individual wheels to prevent vehicles from losing traction and control. Although this is a mandatory regulation, it is another example of a cooperative rulemaking approach in which an agency incorporates an existing industry-developed technology that is already deployed widely by the industry.

Safety Need: Injuries and Fatalities from Vehicle Loss-of-Control Crashes

NHTSA sought to reduce vehicle loss-of-control crashes to minimize deaths resulting from rollover, as most loss-of-control crashes culminate in the vehicle leaving the roadway. NHTSA estimated that mandatory installation of ESC would reduce single-vehicle crashes of passenger

cars by 34% and single-vehicle crashes of sport utility vehicles by 59% (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007).

Solution: Mandatory Regulation Incorporating Existing Industry Voluntary Standards

When NHTSA initiated this rulemaking, OEMs had already installed ESC technology widely. In 2006, nearly 30% of vehicles were ESC-equipped, and OEMs had a roadmap to increase penetration to 71% within 5 years. NHTSA noted that the final rule would merely accelerate the deployment schedule to which the industry had already committed by achieving 100% installation to by 2012. Thus, the mandatory regulation would incrementally increase deployment from 71% of all vehicles by 2011 to 100% in 2012 (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17241).

The heart of the new standard was the definition of ESC and a performance test. However, NHTSA did not develop either the definition or test procedure itself. For the definition of ESC, NHTSA adopted a voluntary consensus definition developed by SAE (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17238). Similarly, the performance test was based on ESC systems already installed on 2005-06 model year vehicles (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17239). Not surprisingly, NHTSA noted that 98% of existing ESC-equipped vehicles were already compliant with the new standard (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17262). Perhaps this explains why NHTSA noted that an "overwhelming majority of the commenters" supported the final rule (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17250).

Rationale

NHTSA contends it was motivated to promulgate this rule because the agency viewed the prevention of vehicle loss-of-control crashes to be the most effective way to reduce rollover deaths, and ESC would most effectively meet this important safety objective (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007). The agency also noted that among its upcoming slate of rulemakings, ESC would reduce total traffic casualties more than any other rulemaking (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17238). Finally, NHTSA boasted that the ESC rulemaking was the most cost-effective of those rulemakings (Federal Motor Vehicle Safety Standards; Electronic Stability Control, 2007, p. 17238). Clearly, the cost-effectiveness of this rule was largely due to the fact that the regulation merely memorialized existing industry standards. Arguably, the cost-effectiveness of the rule would have been significantly lower had NHTSA developed its own standards and test procedures.

Results

Academic commentators from Yale Law School have criticized FMVSS 126 as an example of a mere codification of existing industry practice masquerading as a mandatory, NHTSA-developed regulation (Mashaw and Harfst, 2017). Indeed, NHTSA itself acknowledged that the purpose of the rule was to accelerate incrementally an installation schedule to which the industry had already committed. Given that OEMs had already committed to equipping 71% of their vehicles

with ESC by 2011, presumably the industry may have reached full penetration even without NHTSA's regulation, but this could be said about any voluntary standard with a high commitment rate. This is not to say that the harmony of both industry commitment and voluntary standards cannot eventually evolve into mandatory rulemaking. As the 2016-2021 Guidance for Automated Vehicles case study has shown, an extended period of research and development may be needed to help inform the rulemaking process. A rulemaking process that is inclusive of research and development can be started with a hybrid rulemaking approach, but this generally requires research and development to have reached a point of concrete results that have been repeatedly scientifically tested.

2017 RULEMAKING FOR VEHICLE-TO-VEHICLE COMMUNICATIONS

In 2017, NHTSA proposed FMVSS No. 150, a new standard that requires OEMs to install V2V communications in all new light vehicles (Federal Motor Vehicle Safety Standards; V2V Communications, 2017). More specifically, V2V communications enable vehicles to automatically exchange certain information with other vehicles, including speed, direction, and brake status. NHTSA stated that the exchange of such information, when fused with other vehicle cameras and sensors, "has the potential to revolutionize motor vehicle safety," as the system would provide warnings of impending crash situations, and new V2V-based safety applications could be developed to further prevent collisions (Federal Motor Vehicle Safety Standards; V2V Communications, 2017, p. 3855). Importantly, NHTSA views V2V as a critical enabler of full self-driving vehicles. This regulation, which is currently pending, is a prominent example of NHTSA's use of a mandatory regulation in a field of rapidly evolving technology.

Safety Need: Use of Collision-Avoidance Technology to Reduce or Prevent Crashes

NHTSA contends that the greatest gains in highway safety would arise from broad adoption of crash avoidance technologies (Federal Motor Vehicle Safety Standards; V2V Communications, 2017, p. 3860). V2V technology would meet this important safety objective by providing drivers with timely warnings of impending crash situations, which could reduce the number and extent of crashes (Federal Motor Vehicle Safety Standards; V2V Communications, 2017, p. 3855).

Solution: Mandatory Regulation

Because of the rapidly developing technology involved in V2V communications, NHTSA took the rare step of publishing an Advanced Notice of Proposed Rulemaking (ANPRM) nearly 3 years before publishing a proposed rule. The agency explained that its goal was to present comprehensive information to the public, and invite public participation to help the agency craft its regulation. If the agency's goal was to obtain public input as broadly as possible, it succeeded beyond its own expectations. In response to the ANPRM, NHTSA received more than 900 comments "representing a wider range of perspectives than with other agency safety rules" (Federal Motor Vehicle Safety Standards; V2V Communications, 2017, p. 3876). These comments helped to inform the proposed regulation.

Rationale

After years of research, NHTSA concluded that V2V technology posed two particular challenges that mandated government action in order for benefits to be realized: (1) the need for

interoperable communications among vehicles, and (2) achieving critical mass quickly. Regarding interoperability, without a mandatory common standard, vehicles from different OEMs would not be able to communicate, thereby defeating the objective of V2V technology and "stifling the potential for innovation that the new information environment could create." Regarding critical mass, NHTSA described the market as one characterized by "network effects," meaning that the value of a product increases the more widely it is used by others. Thus, buyers will not demand V2V technology unless they believe that a large number of other buyers will as well. Without buyer demand, OEMs would lack incentives to voluntarily invest in V2V technology. NHTSA stated, "Without government intervention, the resulting uncertainty could undermine manufacturer plans or weaken manufacturers' incentive to develop V2V technology. We are, therefore, confident that . . . this mandate would lead to considerable advances in safety, and that those advances might not reach fruition if V2V communications were left to develop on their own." The agency also specifically eschewed a voluntary approach for V2V technology. NHTSA stated that "[m]anufacturers typically have implemented new vehicle-resident technologies in their more expensive vehicles first. . . . Leaving the pace of that development to the market will, we believe, delay the life-saving benefits" of V2V technology (Federal Motor Vehicle Safety Standards; V2V Communications, 2017, p. 3879).

Results

Academic commentators from Yale Law School approve of NHTSA's mandatory rulemaking approach for V2V technology. The commentators noted that adoption of crash avoidance technologies, such as V2V, suffers from inherently poorer consumer adoption than crashworthiness technologies, such as air bags. This is because crash avoidance technologies confer benefits not only to a vehicle's occupants but are shared with the occupants of other vehicles, pedestrians, and other vehicles. This contrasts, for example, with airbag-equipped vehicles, where the benefits are fully internalized to the vehicle's occupants. Thus, commentators argue, consumers have weaker incentives to invest in crash avoidance technology because the longer they hold out, the more likely that other such vehicles are already on the road and can avoid colliding with them (Mashaw and Harfst, 2017, pp. 273-4). Because of diminished consumer demand for crash avoidance technologies, commentators contend that a government mandate may be required to overcome this obstacle and force adoption.

CHAPTER 5. AGENCY-SPECIFIC CONSENSUS RULEMAKING

More than two decades ago, the FRA pioneered a model of rulemaking that is believed to be unique among federal agencies (Railroad Workplace Safety; Roadway Worker Protection Miscellaneous Revisions, 2016). This model, which can be called "consensus rulemaking," is analogous to negotiated rulemaking, but with several key distinctions designed to facilitate the likelihood of reaching a consensus between industry and the agency. Like negotiated rulemaking, consensus rulemaking uses an advisory committee comprised of industry and agency representatives to reach consensus on a regulation, with the goal of producing a regulation that is more acceptable to all parties involved in less time than under traditional rulemaking. Unlike negotiated rulemaking, however, advisory committees under the FRA's model follow a different structure and function. The FRA's model uses a standing committee (instead of forming a new committee for each new regulation) with individual working groups (rare in negotiated rulemaking). It also has a significantly larger membership with broader industry representation than negotiated rulemaking, and permits flexibility concerning the level and degree of consensus, among other differences. One prominent case study of consensus rulemaking follows.

Safety Need: Transportation of Crude Oil and Ethanol by Rail

The previous decade's surge in U.S. oil and ethanol production has led to increased transportation of these hazardous chemicals by rail, which in turn has led to significant safety challenges and numerous accidents (Wiseman, 2017, pp. 226-29). Congress, however, was slow in enacting solutions to address safety issues involved in the transportation of crude oil and ethanol. Most legislation focused on imposing penalties for non-compliance with DOT safety standards, licensing and training requirement for operators, and requirements for installation of event recorders and other equipment (Wiseman, 2017, pp. 229-31). Congress would not enact a comprehensive solution until passage of the Fixing America's Surface Transportation Act in 2015 (Wiseman, 2017, p. 232).

Solution

Because legislation was slow to address safety issues from the transportation of crude oil and ethanol, in 2012 the FRA and the PHMSA began to issue regulations to fill this void (Wiseman, 2017, p. 234). In 2013, under its consensus rulemaking model, FRA assigned its standing advisory committee, the Railroad Safety Advisory Committee (RSAC), to develop regulations concerning tank car standards and operational controls (PHMSA, 2016). RSAC working groups reached consensus and made recommendations to the full RSAC (Wiseman, 2017, p. 247). Just one year after being tasked, FRA published a proposed regulation, with a final regulation following in an additional year (Hazardous Materials, 2014; Securement, 2015). This is a significantly shorter timeline than under traditional rulemaking, and RSAC's innovative structure likely facilitated achieving consensus.

Rationale

FRA believes that its model of consensus rulemaking is more efficient, promotes greater engagement with industry stakeholders, produces higher quality regulations, and can be implemented more effectively than would be possible under other models of rulemaking.

Results

From 1996 to 2016, the FRA has used its innovative model of consensus rulemaking successfully to complete more than 40 regulatory tasks (Wiseman, 2017, p. 225). But even when this model does not produce a consensus, the FRA and PHMSA note that the process provides the agencies with knowledge that subsequently produces benefits for other regulations. For example, RSAC was working on developing a standard for the acceptable minimum crew size for trains transporting flammable liquids, but failed to reach a consensus. However, the FRA and PHMSA used information developed by RSAC to inform a subsequent regulation on train crew sizes (Wiseman, 2017, p. 248). Both agencies have described how influential RSAC was in developing the regulation (Train Crew Staffing, 2016, pp. 13936-37). One commentator has opined that the consensus rulemaking process, which provides repeat interactions with the industry, provides long-term knowledge in highly technical areas that enables the agency to quickly respond to risks (Wiseman, 2017, pp. 270-73).

In an era of rapidly developing technology, this approach may be a useful method for developing informed regulations related to automated vehicle technology. On the other hand, automated technology requires much more than just automobile manufacturers. There are hardware and software components that involve additional actors, such as software programmers, GPS technology companies, and lidar and radar sensor developers. With many emerging technology start-up companies, a standing committee with the same membership may not be the most representative for informed rulemaking. Each policy situation would need to be examined critically to determine the best approach.

In AV 1.0, NHTSA shared some alternative tools they are examining for how to regulate ADS deployment in the interim of a final rule. One of the alternatives includes expanding the cap on vehicle exemptions and length of time of such exemptions to facilitate safety testing and introduction (NHTSA AV 1.0, 2016). In the U.S., many states are passing their own legislation for the testing and deployment of automated vehicles on state public roads (Ilková & Ilka, 2016). In order to ensure public safety, NHTSA has suggested pre-market testing, data, and analyses to state DOTs and the potential for pre-market approval, which would depart from the current self-certification system. AV 1.0 also discusses cease and desist orders should a risk be identified that requires immediate action on behalf of the manufacturer. Several of these modern regulatory tools show that a new style of rulemaking may be emerging in an effort to facilitate testing and deployment without mandatory regulations until further research and development can be conducted (NHTSA AV 1.0, 2016).

CHAPTER 6. CONCLUSIONS

As the case studies have shown, NHTSA has adopted various approaches to regulating rapid innovation and technological development. An analysis of the circumstances that led NHTSA to select particular models provides some guidance in determining their appropriateness for certain applications.

First, regarding the three non-regulatory case studies (Distracted Driver Guidelines, AEB, and ADS), NHTSA justified a non-regulatory or voluntary approach by reciting broadly that a static regulation risked impeding innovation, but the agency did not specifically identify unique features of those technologies that would be harmed by mandatory regulation. Moreover, it is notable that the European Union, Japan, Russia, and South Korea have adopted a mandatory approach to regulating AEB.

Second, the two cooperative rulemaking cases (Side Impact Test and ESC) were notable because NHTSA was under time pressure to implement a congressional mandate that required the completion of rulemaking in a short period of time. Arguably, the urgency forced NHTSA to rely heavily on incorporating existing industry practice instead of developing a more robust standard based on its own expertise.

Third, the negotiated rulemakings for headlamps and multistage vehicles are curious cases. These were the first, and remain the only, negotiated rulemakings that NHTSA has pursued. NHTSA has not explained specifically why both efforts resulted in such diametrically opposed outcomes. This absence of guidance makes it difficult to determine the suitability of negotiated rulemaking for different cases.

Fourth, although V2V communications represents an area of rapid innovation, NHTSA did not hesitate to pursue a regulatory approach. NHTSA articulated a clear rationale why a non-regulatory approach would not have worked: V2V communications require interoperability among vehicles from different manufacturers, and the market exhibited network effects, which warrant a mandatory regulation. But as NHTSA demonstrated in its approach to ADS, significant flexibility can exist within the rulemaking process by expediting waivers from obligations in regulations. This shows that even mandatory regulations can be quickly adapted to address innovation.

Contrary to popular belief, non-regulatory and regulatory approaches are not binary choices. An examination of NHTSA's use of mandatory regulations for innovative technologies shows a continuum of at least three different models with varying degrees of industry involvement. In particular, negotiated rulemakings closely resemble a voluntary approach with the imprimatur of the government. Similarly, the cooperative model also reflects considerable industry influence. Although administrative rulemakings provide only limited opportunity for back-and-forth engagement, NHTSA's invitation to the industry for exemptions for ADS demonstrates that even this rigid model is capable of sufficient flexibility to accommodate innovation. As discussed, agencies have a diverse arsenal of regulatory tools to address rapid innovation. Determining which regulatory model is best suited to address a particular technology requires a nuanced, fact-specific inquiry of the technology, market, and other circumstances.

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