Performance Standards vs. Design Standards

Facilitating a Shift toward Best Practices

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Abstract

Performance standards are typically viewed as a preferable regulatory approach to design standards. Presidential administrations and offices have consistently instructed regulatory agencies to favor performance standards when feasible. Nevertheless, research shows that in many instances, agencies opt for design standards even when performance standards would likely lead to better outcomes. Following a discussion of the benefits and drawbacks of performance standards, we lay out some general principles for agencies when considering alternative regulatory approaches. These principles are intended to help agencies determine whether performance standards are preferable to design standards given the particular aspects of any regulatory issue, and to help agencies avoid potential pitfalls when crafting performance standards. We then present two case studies of recent actions by regulatory agencies—the Federal Railroad Administration and the Federal Aviation Administration—that demonstrate how to shift from design standards to performance standards.

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1. Introduction

Performance standards and design standards are two approaches that government agencies may consider when crafting regulations for the purpose of achieving a behavioral outcome. A performance standard establishes a goal that regulated parties must achieve, often characterized by a threshold above or below which a regulated entity must remain. For example, a performance standard may require that all cars produced after a given year meet specific emission standards. A design standard, on the other hand, mandates that regulated parties employ a particular means of compliance. For example, a design standard may require that all cars produced after a given year be equipped with a specific type of catalytic converter (a device that reduces the toxicity of emissions). The difference is that performance standards allow the regulated entity to meet the standard in whatever way it chooses (within the constraints of the law), whereas design standards mandate the approach that the regulated entity must take to meet the standard. Owing to the added flexibility, well-crafted performance standards are often more effective and efficient than design standards. By following some general principles, regulators can determine when and how to implement performance standards in new regulations or as modifications to existing regulations.

No single model for performance or design standards exists, and few regulatory actions are strictly performance standards or design standards. As Coglianese, Nash, and Olmstead (2003) explain, it is generally more appropriate to consider the two categories

> . . . as end points along a spectrum of regulatory approaches. In other words, when setting standards, regulatory agencies usually select a point on a spectrum running from what might be considered "pure" performance standards to "pure" design standards, depending on the level of discretion afforded the targets of regulation. (p. 713)

As one author frequently heard in the halls of the Federal Aviation Administration (FAA), the purest performance standard is, "Be safe." Clearly, there is more to crafting an acceptable performance standard than such a vague direction.

One court's observation highlights the role specificity plays in determining where a standard lies on the continuum:

> Although design and performance standards are analytically distinct, in practice the line is not so clear. For example, a performance standard requiring that a vehicle's driver should be able to see in the dark is not very different from a design standard requiring that a vehicle have lights. (Wood v. General Motors Corp., 1988)

Rather than simply directing the regulated entities to design safe vehicles, an agency may address a host of specifics related to vehicle safety, sometimes in a prescriptive fashion and other times in a more performance-based fashion. The metric at issue in the court's example above is visibility. And although the court's point is well taken, it perhaps exhibits a lack of imagination. For this issue, lights may always be an acceptable means of compliance. However, at some point in the development of technology, it may prove cheaper to add an infrared capability to a vehicle than to require lights. Even so, addressing components such as lights or performance metrics such as visibility is still more specific than saying, "Be safe."

To an extent, we should expect such variation because of the contextual nature of regulatory actions. Agencies create regulations to respond to specific problems, so they should tailor their responses to industry conditions, risks to the public, consumer demand, asymmetric

information, and interaction with other existing rules (Sinclair, 1997, pp. 529–59).[1] Agencies also have differing legal mandates that may influence whether performance or design standards are more feasible. Furthermore, other regulatory approaches, such as those less intrusive than performance standards, fall outside this spectrum. For example, management-based regulation, information disclosure requirements, and voluntary programs and self-regulation initiatives (Carrigan and Coglianese, 2011, p. 114) are all alternative means of achieving regulatory goals that cannot be described as performance or design standards. Nevertheless, regulation intended to influence technological design or business operation has largely taken the form of performance or design standards (for more information on these approaches, see Carrigan and Coglianese, 2011, p. 114), and focusing on regulations that fall along the spectrum between these two approaches is helpful for developing general principles for improving regulatory analysis and decision-making.

At a fundamental level, performance standards incorporate choice by allowing firms and individuals to determine the best way to comply with a regulation. These standards are a results-oriented approach in which compliance is contingent on the regulated parties meeting an objective or set of criteria. In short, performance standards specify outcomes that regulated entities must achieve but not the methods that regulated entities must use (Coglianese, Nash, and Olmstead, 2003, p. 709). According to Hemenway, the essential parts of a performance standard are the requirement, the criterion, and the test (1980, p. 1). Requirements are the qualitative

[1] For example, even within the purview of a particular regulating agency, such as the Environmental Protection Agency, many factors require fashioning regulations to be context specific. See Sinclair (1997, p. 552): "One of the major barriers to the development of an ideal system of regulation is the context-specific nature of most, if not all, environmental issues. There are a myriad of possible variations, including differences in industry structure, costs and benefits, technological solutions, prevailing business culture, and assimilative capacities, that collectively make up the wide variety of environmental issues now confronting policymakers. While a particular regulatory regime may be effective in one circumstance, there is no guarantee that it will work equally as well in another. In order for policymakers to overcome this dilemma, they must be able to tailor their regulatory solutions to the unique circumstances of each environmental issue at hand."

statements that relate to the activities or qualities the rule is attempting to enforce. Criteria are the quantitative measures—such as minimum or maximum levels—that correspond to the intent of the requirement. And tests are the methods of assessment used to gauge if a firm satisfactorily adheres to the relevant requirements and criteria (Hemenway, 1980, p. 1).

Since performance standards often require setting a target, levels of stringency for these standards vary, sometimes quite significantly. Tiered objectives are a common way for regulators to broaden the applicability of performance standards and acknowledge the substantial product differentiation within markets. For example, a highway safety regulation may offer different requirements depending on the size or class of a vehicle.

Design standards, also called prescriptive standards, dictate the method by which regulated entities must achieve a goal. For example, an agency may mandate that firms use a specific type of technology, update a piece of equipment, or take a certain action to meet regulatory requirements. A more flexible rule could offer firms a choice among a suite of technologies. In a more qualitative context, an agency could mandate behaviors or methods of compliance instead of picking a technology to use. Nevertheless, the defining characteristic of design standards is that regulators articulate *how* individuals or firms must achieve particular goals.

Although agencies may use either the performance-standard or the design-standard approach with the intention of achieving a single goal, the inherent differences between these approaches often lead to different outcomes. When practicable, performance standards are typically considered a best practice for rulemaking. As early as 1980, a consensus among federal agencies had emerged that performance standards were preferable to their more prescriptive counterparts (Hemenway, 1980, p. 5). In 1993, the Clinton administration instructed agencies in

Executive Order 12866 to "specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt" (Exec. Order No. 12866, 1993). Each subsequent administration has upheld the same principles of regulation by explicitly reaffirming Executive Order 12866 or implicitly affirming it by leaving it in place. For instance, the Obama administration highlighted the importance of performance objectives and flexible approaches in Executive Order 13563, which supplemented Executive Order 12866 (Exec. Order No. 13563, 2011).

Building on Executive Order 12866, the Office of Management and Budget's (OMB) Circular A-4—the official document that details best practices for regulatory analysis within executive branch agencies—states that performance standards are "generally superior to engineering or design standards" (Office of Management and Budget, 2003). Circular A-4 goes further to provide a fundamental reason for preferring performance standards over design standards—by focusing on outcomes rather than the means of compliance, performance standards allow regulated entities the discretion to comply in the most cost-effective way available to them (Office of Management and Budget, 2003).

Although performance standards are generally accepted as a best practice in most situations (we will discuss later when design standards may be superior to performance standards), it is not uncommon for agencies to implement design standards even when performance standards would lead to better outcomes (for example, see Blumenauer, 2011, pp. 358–62). It is difficult to say definitively why this is so, especially given the presidential directives to give preference to performance standards. It is possible that some agencies choose design standards because they are easier to analyze, monitor, and enforce. In some cases, authorizing legislation may give incentives or instructions for agencies to prioritize design

standards. It could also be that businesses standing to benefit from design standards successfully lobby for those actions.

A fourth possibility is that agencies are concerned about the uncertainty of outcomes and the potential pitfalls associated with poorly drafted performance standards. Thus, while agencies are instructed to favor performance standards (and may understand intuitively why these standards are likely preferable), they may worry that the potential costs are too high or too difficult to forecast. It is this final possibility that we seek to mitigate through this paper.

Our hope is that this paper provides the necessary insights for agencies to make more informed decisions when deciding whether and how to regulate. The remainder of this paper will summarize the major potential benefits and drawbacks of performance standards, as well as discuss some general principles for agencies to follow when creating new regulations or reviewing and modifying existing ones. The paper is structured as follows. Sections 2 and 3 review the major potential benefits and drawbacks of performance standards relative to design standards. Section 4 lays out steps that agencies can take to ensure that they structure standards effectively. Section 5 describes considerations for agencies shifting from design-based to performance-based standards, including examples of two agencies undertaking this task. Section 6 concludes with a summary of the paper and a discussion of the potential benefits, should agencies adopt the principles laid out in this paper.

2. The Potential Benefits of Performance Standards

Performance standards have a number of theoretical advantages over design standards. The most important of these are that they allow private actors to choose the approach best suited to each actor's situation, they leave open the opportunity for innovation rather than locking in technology, and they help ensure a fair playing field for regulated entities.

Allowing for Choice in Compliance

Government agencies have limited information about the particular conditions that regulated entities face, and the conditions and preferences of individual regulated entities are likely to differ. As Black, Hopper, and Band (2007) explain, the economic logic of performance standards "is based on the idea that firms and their management are better placed than regulators to determine what processes and actions are required within their businesses to achieve a given regulatory objective" (Black, Hopper, and Band, 2007, p. 192). The regulated entities can then choose the least costly method, lowering the total cost of the standard. Design standards choose the compliance technology for all businesses, likely raising costs for some and giving advantages to those that would prefer the chosen technology.

Leaving the Door Open for Innovation

Performance standards allow for innovation and entrepreneurship in compliance, while design standards often discourage or even outlaw such activity. With performance standards, firms are not necessarily restricted to a preexisting set of compliance options but can seek alternative low-cost strategies, improve on existing methods, and invent innovative ways to meet the target (Coglianese and Kagan, 2007, p. xxiv). Permitting different approaches to compliance elicits competition among regulated entities so that better, more efficient approaches are more likely to be adopted. By rewarding "behaviors directed at the desired outcome rather than at compliance tasks," performance standards help align the incentives of entrepreneurs with the goals of the agencies (Hobson, 2017, p. 8).

Design standards, on the other hand, may lock in outdated countermeasures to evolving problems. One way that agencies have attempted to make some design standards more like performance standards is to include equivalency clauses or waiver provisions, which allow firms

to use means other than the design standard to achieve the goal (Coglianese, Nash, and Olmstead, 2003). However, this creates additional search costs or uncertainty for firms, and firms are unlikely to achieve the same level of innovation that they would under a true performance standard.

Ensuring a Fair Playing Field

When properly crafted, performance standards can work to mitigate government favoritism and reduce unintended disproportionate burdens of regulation. As the literature on public choice economics has documented, the regulatory process is susceptible to rent-seeking—a process by which private businesses seek regulations that benefit them at the expense of their competitors. This process can lead to unfair rules that grant certain firms or industries market power based on political influence rather than on providing value to customers (Mitchell, 2014, and Djankov et al., 2002, pp. 1–37). May (2007) explains that performance standards help "provide a more level playing field" by avoiding prescriptions that favor "particular producers" over competitors or "at the expense of the public interest" (May, 2007, p. 23).[2] Performance standards limit the ability of firms to rent-seek and generally reduce unfairness because they do not dictate how firms must act, and they are more difficult to structure in a way that benefits specific firms at the expense of others. However, if an agency selects a specific technology through a design standard, then the regulation codifies a guaranteed market for the seller of that technology and an advantage for businesses whose processes are more compatible with

[2] Additionally, May (2007, p. 23) explains how performance standards help reduce the "local form" of regulatory capture (e.g., favoring one producer over another), but they may be less effective at mitigating the more "global form" of capture where "entire industries are favored if they gain from exclusionary practices." Nevertheless, combining performance standards with regulatory impact analysis by agencies, centralized review of agency economic analyses, and retrospective review can help prevent global forms of regulatory capture.

that technology. This result will occur regardless of whether the intent is to favor some businesses or not.

On the other hand, some scholars have pointed to fairness as a potential drawback of performance standards. For example, Coglianese, Nash, and Olmstead (2003) report, "Performance-based regulations may impose excessive costs on business, particularly small firms, because firms must search for ways to meet regulatory standards. Some firms may simply prefer to be told exactly what to do, rather than incur costs to identify steps needed to achieve a performance standard" (Coglianese, Nash, and Olmstead, 2003, p. 712). There are also concerns that some firms or industries may be better positioned than others to take advantage of the alternative approaches permitted by performance standards due to factors other than size (May, 2003, pp. 388–89).[3] In some of these cases, however, it seems as though design standards would be fairer to some of the regulated entities but unfair to the consumers, as the consumers will likely bear the costs of reduced efficiency and innovation that come with locking in a specific technology. Furthermore, as we mentioned in the previous paragraph, ensuring a fair playing field is usually a benefit of performance standards, assuming the standard is properly crafted.

3. The Potential Drawbacks of Performance Standards

The economic and administrative drawbacks to implementing performance standards may go some way toward explaining why agencies do not always initially reach for performance standards as the first tool in the regulatory toolbox. First, it is important to acknowledge that poorly crafted or implemented performance standards "will function poorly, as will any

[3] For example, differences in enforcement can lead to inequities. Another example is differences in technical capabilities. Some firms may be able to provide computer simulations to prove compliance, while other firms must use expensive field tests.

regulatory instrument that is ineffectually deployed" (Coglianese, Nash, and Olmstead, 2003, p. 708). Thus, a chief concern associated with—but not unique to—performance standards is poorly crafted regulations. Aside from poorly crafted regulations, performance standards can also potentially lead to bad outcomes by limiting flexibility, forcing new technology, creating uncertainty, producing unintended consequences, failing to achieve the regulatory goal, or not meeting theoretical expectations. Not all these potential drawbacks necessarily lead to poor outcomes for any given performance standard because a vigilant regulator can often avoid or mitigate the negative effects. Nevertheless, a number of concerns arise in the context of performance standards.

Limiting Flexibility

Even performance standards may run the risk of reducing flexibility. If a regulatory standard is "defined very narrowly, for example, by specifying the performance of a pump in an industrial process," a rule "may actually offer little discretion to regulated entities" (Coglianese, Nash, and Olmstead, 2003, pp. 711–12). Even if regulators establish a broader performance standard, a rule that also dictates a strict approval process may eschew benefits of discretion and flexibility (Coglianese, Nash, and Olmstead, 2003, p. 712). While an advantage of performance standards is that they typically reduce the regulatory burden on businesses and the economy, they could potentially have the opposite effect, becoming a de facto design standard or worse. Coglianese (2017) describes an example of how performance standards can continuously grow to become potentially more onerous than design standards:

> In order to give manufacturers discretion to choose how to reduce NOx emissions, the EPA [Environmental Protection Agency] added layer upon layer of requirements that, over the years, have grown to an extraordinary level of prescriptiveness in how emissions testing must be done. Engine manufacturers now employ teams of engineers to understand and comply with these requirements. Moreover, even when industry experts

> think they have met the government's tests, the EPA still can threaten to withhold a certificate of conformity and pursue enforcement actions against manufacturers. This is far from a system that fosters simplicity and certainty. Not only are the costs and complexity of these emissions performance standards a burden for industry; they have not proven easy or cheap for government to design. It has taken the agency decades to refine its testing protocols. (p. 563)

Forcing New Technology

Another potential concern with performance standards is agencies using strict requirements to force industries to create technologies that do not yet exist. In a review of the relationship between performance standards and technological change in the automobile industry, Vinsel (2015) warns against the problem of crafting "technology-forcing" standards if the objective is too restrictive or narrowly defined (p. 871). Technology-forcing standards establish targets that "are set so stringently that no current, available, or off-the-shelf technology can meet them, thereby forcing firms to carry out research and development (R&D) to do so" (Vinsel, 2015, p. 871). Vinsel (2015) argues that the emission control standards included in the Clean Air Act Amendments of 1970 were "perhaps the toughest technology-forcing standards in U.S. history" because they caused vehicle manufacturers to develop (or rely on other countries to develop) and install catalytic converters in all vehicles sold in the United States (pp. 884–85).

Creating Uncertainty

Even loose performance standards can have serious implications for market structure. This is because performance standards do not always make clear what must be done to achieve or satisfy the standard (Deighton-Smith, 2008, pp. 41–56; see also May, 2003, p. 388). Summarizing the discussion of a workshop on performance standards, Coglianese, Nash, and Olmstead (2003) point to a concern that "regulated entities can be uncomfortable with loosely specified performance standards because they believe they give regulators too much discretion

when deciding enforcement issues" (p. 10; see also May, 2003, pp. 381–401). This means that potential applicants for approval may be uncertain whether they will receive approval, and other regulated entities may be uncertain whether they will be fined. Furthermore, regulated entities may wonder if other firms will receive the same treatment.

May (2003) also discusses this concern in detail:

> The design of a regulation is only part of the equation. Although a regulation may be designed to promote innovation, encourage flexibility, or minimize compliance costs, the reality of that regulation rests on what regulatory agents do in the field when enforcing the regulation and monitoring performance (*also see* Bardach and Kagan 1982:34–35). Here is where the potential for inequities and inconsistencies arise. . . .
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> * * *
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> As found by May and Wood (2003) in studying homebuilders, regulated entities will react negatively to the lack of predictability if performance-based regulations are inconsistently interpreted. Similarly, regulated entities will see little improvement over the prior more prescriptive regulations if performance-based regulations are interpreted too narrowly in allowing for a limited range of solutions. (p. 388)

However, with design standards, regulated entities may be confident that so long as they implement the design, they will receive regulatory approval.

Likewise, the demonstration of compliance with a particular standard may not be equitable among applicants. One applicant may be allowed to provide a computer simulation as to the feasibility of a design. Another may find it must perform expensive field tests. May (2003) describes a similar phenomenon in the prescriptive world of building safety (p. 390). There, where building codes have become so detailed and complex that an inspector must exercise discretion in what provisions to enforce, there is also room for inequitable treatment of regulated entities (May, 2003, p. 390). When confronting new technologies, a potential pitfall of agency performance standards is that the agency may fail to disclose what constitutes an acceptable demonstration that the regulated entity has satisfied the standard.

Creating Unintended Consequences

Another concern is the potential for unintended consequences. Both types of standards run the risk of unintended consequences from basic tradeoffs in expenditures and unforeseen results of new technologies. However, performance standards carry a greater risk because the agency might not know all the technologies that regulated entities will use to comply with the new standard. For example, in the absence of an emission standard, car producers may forgo a new technology that would lower emissions because it also increases the immediate risk to the passengers of the vehicle. However, performance standards on emissions may push the car producers to implement this technology, thus lowering emissions but increasing injuries or fatalities.

Failing to Achieve the Regulatory Goal

The ability of agencies to accurately and consistently measure outcomes is an essential facet of effective regulations. Therefore, measurement challenges associated with performance standards are a substantial barrier to successful implementation. As Coglianese (2012) explains, outcome evaluations of a regulation's effectiveness are based on (1) indicators or "empirical measures of outcomes," and (2) attribution, which refers to "empirical inferences about the extent to which the treatment has actually caused any of the observed changes in indicators" (p. 15).[4] Performance standards are most appropriate when agencies can reasonably institute measurement, monitoring, and verification (Coglianese, Nash, and Olmstead, 2003, pp. 708, 715, 719). Using poorly crafted quantitative measures as "proxies for quality of

[4] On pp. 14–15, Coglianese notes that the term *evaluation* is often used in different contexts: administering regulations, behavioral changes, and improvements or deteriorations in outcomes. In the rest of the article, evaluation refers to the third context—outcome performance.

behavior" can incentivize activities that are inconsistent with the intent of the rule (Black, Harper, and Band, 2007, p. 199). Some measures may be incomplete or arbitrary, or may fail to capture the relevant information to truly evaluate outcomes. One such issue is the potential of businesses "teaching to the test," where regulated entities find ways to meet the requirements but fail to meet the regulatory objective.

A related concern to measurement is the difficulty of devising tests to evaluate compliance with a rule. Formulating feasible tests that align with the quantitative criteria is challenging, especially when moving beyond objective measures. Hemenway (1980) notes how the process of writing standards and creating test methods is more difficult when the process of evaluating product characteristics requires subjective judgments, when controlled testing is costly, or when simulations provide "inadequate representation of actual conditions" (p. 5). In these circumstances, performance standards may be less appropriate—or at least more costly to enforce—than in contexts where objective metrics are available for measurement and testing.

Measurement may be one area where performance standards suffer by comparison with prescriptive standards. Not all performance standards include a means of measuring compliance. When an applicant approaches an agency with an innovative design, how will the agency determine whether it satisfies the performance requirement? If the agency does not disclose this metric by regulation, or leaves it to a host of possibilities, regulatory uncertainty and possible inequitable treatment may remain. Some regulations lend themselves easily to measurement. A regulator may, for example, test emissions for acceptable concentration levels. However, in the course of developing new technology, establishing a measure may be premature. Just as the regulated entity is still testing its technology, the regulator may need to wait to impose a requirement. For example, in 14 C.F.R. § 460.5(b), the FAA requires that

> each member of a flight crew [aboard a licensed or permitted launch or reentry] must demonstrate an ability to withstand the stresses of space flight, which may include high acceleration or deceleration, microgravity, and vibration, in sufficient condition to safely carry out his or her duties so that the vehicle will not harm the public.
> (Montgomery, 2017)

"In sufficient condition" to carry out one's duties shows that a commercial flight crew member need not be a superhuman astronaut. One might only need to retain sufficient consciousness to work the controls. That the flight "may" include high acceleration suggests that all flights might *not* include that particular stress of space flight. If a capsule gets to space via a balloon, the operator might not need to demonstrate to the FAA that the crew member can withstand high acceleration. The requirement, in other words, may be tailored to the technology, and applicants need only demonstrate that their crew can withstand the stresses of a particular vehicle.

However, what the regulation does not say is what a successful demonstration of compliance looks like. Does the flight crew have to undergo the anticipated stresses? How many times? To what level of reliability? Nine times out of ten? Ninety-nine times out of a hundred? The answers to these questions may reveal hidden costs of the regulation. While applicants get to make their individual cases for their own vehicles, operators of similar vehicles should be treated similarly. One crew member should not be required to undergo hours of high acceleration testing while another one is subjected to only minutes unless the differences in the mission profile warrant such differences in testing.

This problem could surface in the regulation of any new technology. However, if an agency knows what its test will look like because the regulated industry is more mature than that of human space flight, the regulator should make that clear by including it in the regulation. This will avoid the perils of uncertainty and lack of notice or transparency.

Finally, measurement difficulties may leave open the opportunity for fraud or evasive behavior (Coglianese, 2017, pp. 559–60). The recent Volkswagen scandal, in which the company installed software to make its cars perform differently while being tested for emissions, embodies this potential problem.[5]

Failing to Meet Theoretical Expectations

Beyond the measurement challenges discussed herein, scholars have critiqued the lack of empirical analysis on the effectiveness of performance standards on a broader level. Coglianese, Nash, and Olmstead (2003) report that even workshop participants who preferred performance standards to design standards "acknowledged that there is a dearth of empirical studies aimed at measuring the effectiveness of performance-based standards" (Coglianese, Nash, and Olmstead, 2003, p. 713).

Although there is not a lot of research, some research does exist on specific performance-based regulatory programs or case studies of performance standards. According to Coglianese (2017), as of 2017, there were two empirical studies on performance standards (p. 528, footnote 12). First, May (2003) assesses the success of performance-based building code regulations in New Zealand and concludes that "without sufficient accountability," the increased flexibility of New Zealand's regulatory regime led to worse outcomes (May, 2003, pp. 381–401). Second, Auffhammer and Kellogg (2011) look at gasoline content regulations in the United States and find that offering compliance flexibility to refiners did not result in lower ozone pollution and better air quality (Auffhammer and Kellogg, 2011).

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[5] See the following articles summarizing Volkswagen's admission to cheating US emissions tests: https://www.bbc.com/news/business-34324772; https://www.caranddriver.com/news/a15339250/everything-you-need-to-know-about-the-vw-diesel-emissions-scandal/.

Furthermore, since the Coglianese, Nash, and Olmstead (2003) article was published, a few more empirical studies have contributed knowledge on performance-based regulation.[6] Thornton, Kagan, and Gunningham (2008) examine the "technology-forcing emissions reduction standards on diesel engine manufacturers" that the Environmental Protection Agency imposed on new model year vehicles (pp. 275–92), While the maximum emissions standards were strict enough to substantially affect the environmental performance of new diesel engines, the standards did not directly impact in-use vehicles (Thornton, Kagan, and Gunningham, 2008, p. 279). As a result, company-level environmental performance varied widely because the regulations were limited in their ability to cause the trucking industry to shift to newer, cleaner vehicles (Thornton, Kagan, and Gunningham, 2008, pp. 285, 288). Greenstone (2004) evaluates the impact of the Clean Air Act and its amendments on sulfur dioxide concentrations, specifically through the National Ambient Air Quality Standards, which required counties to meet minimum air quality levels. Under the legislation, the EPA would designate counties not meeting the standards with nonattainment status to encourage compliance. Nevertheless, Greenstone (2004) "finds that the nonattainment designation played a minor role in the dramatic reduction of SO_2 concentrations" (p. 587). May (2007) looks at four case studies of regulatory regimes—including two performance-based experiences—to provide "limited snapshots" of these efforts and their associated accountability issues (p. 14). May concludes that accountability issues were critical factors in the cases of using performance-based regulation for building safety in New Zealand and fire safety in the United States. Drawing from these case studies, the article emphasizes the "importance of finding the right fit between regulatory circumstances and the design of regulatory regimes" (May, 2007, p. 8).

[6] We are considering studies that are empirical in the sense of using information or data acquired through observation or experimentation to evaluate the outcomes of a performance standard.

The existing empirical work on performance standards is most useful for identifying the effectiveness of the specific programs evaluated in those studies. In particular, the literature highlights how accountability and enforcement problems limit the success of performance standards, although the results do not necessarily translate to systematic empirical findings that prove the efficacy of performance standards.

Similarly, the lack of broader meta-analyses of the effectiveness of performance standards remains a gap in the literature. Systematic evaluations of how performance standards fare, beyond anecdotal case studies, would offer insight into the expected results of adopting outcome-based regulation on a wider scale. Without such analysis, there is no certainty that performance standards will meet theoretical expectations.[7]

4. How to Mitigate Drawbacks of Performance Standards

As with other regulatory tools, performance standards are not immune to the more general pitfalls of creating and enforcing government regulations. But if agencies carefully craft performance standards, they can often mitigate many of the potential drawbacks.

Poorly designed performance standards are often the products of an unsound regulatory process. Ignoring the best practices identified in Executive Order 12866 and OMB Circular A-4 can have negative implications for regulatory rulemaking regardless of the form or type of

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[7] For example, Thornton, Kagan, and Gunningham (2008, p. 275) caution that their results are limited in scope: "This article reports the results of an empirical study of the regulation of emissions from heavy-duty diesel trucks in the US. As a single case study, it cannot provide any definitive answer to the two problems." Also, while May (2007) offers a thorough comparison among four case studies (two focusing on performance standards), its limited scope and small sample size make it difficult to extrapolate conclusions on the broader efficacy of performance standards. See May (2007, p. 14): "The cases are necessarily selective as they have been chosen from regulatory situations for which accountability issues were notable. Although the cases illustrate the potential for accountability shortfalls in system-based and performance-based regimes, they clearly do not suggest that such shortfalls are inevitable; a topic that is addressed more fully in the conclusions. . . . Given the constraints of space and the continuing evolution of each regime, the depictions that follow can only be considered limited snapshots."

regulation. In many cases, ensuring that agencies identify a systemic problem, evaluate a wide range of alternatives (including "no action"), and calculate the net benefits of each alternative can reduce the likelihood that agencies implement performance standards with serious adverse effects just as they help prevent any other type of regulation with adverse effects. These practices will help agencies regulate only when necessary, choose the appropriate approach given the characteristics of the problem and potential solutions, and create effective standards based on the circumstances. This approach to regulating has the added benefit that it is not inherently biased toward performance or design standards. When design standards have a preferable outcome for society, following these practices will lead agencies to forgo performance standards.

The first principle outlined in Executive Order 12866 states that "each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new regulatory action) as well as assess the significance of that problem" (Exec. Order No. 12866, 1993, p. 1). Circular A-4 expands on this point with instructions that agencies should identify and describe a market failure if applicable or "provide a demonstration of compelling social purpose and the likelihood of effective action" (OMB Circular A-4, 2003, p. 4).

This identification of a systemic problem helps regulatory agencies in two ways. First, it ensures that agencies are using their time and resources to try to solve problems that can actually be addressed by regulation. Second, understanding the nature and causes of the problem at hand will help agencies design regulations that address problems rather than symptoms. This can help agencies ensure that they achieve the goal of a performance standard and avoid problems created by poorly crafted quantitative measures that do not address the real problem. However, agencies often fall short of sufficiently identifying or analyzing a systemic problem. The Mercatus

Center's Regulatory Report Card evaluates how well agencies comply with the major principles of Executive Order 12866 and Circular A-4. "Assessment of the systemic problem" earned the lowest score of any regulatory analysis criterion that the Report Card evaluated (second-lowest for all principles) (Ellig, 2016; "assessment of the systemic problem" received an average of 2.2 out of 5).

As with identifying a systemic problem, Executive Order 12866 and Circular A-4 direct agencies to consider a wide range of alternatives. As Broughel and Ellig explain, agencies "are expected to assess a wide variety of alternatives to inform the president and Congress" when crafting regulations (Broughel and Ellig, 2012, p. 1). Following best practices, agencies should consider numerous federal alternatives, nonfederal options, and nonregulatory approaches as well as compare the net benefits of each approach (Broughel and Ellig, 2012, pp. 2–3). When analyzing these alternatives, agencies should also consider varying degrees of the same regulatory approach, such as different levels of stringency for performance standards. This will help agencies avoid the problems associated with overly broad or stringent performance standards (i.e., limiting flexibility, forcing new technology and thus failing to account for costs in the agency's regulatory analysis, and creating unintended consequences).

Furthermore, this analysis will give agencies the information they need to determine whether a performance standard is the correct approach, or whether some other alternative is likely to lead to better outcomes. Although examining alternatives is included as a best practice in Executive Order 12866 and Circular A-4, the Mercatus Center's Regulatory Report Card finds that only 19 percent of the regulations evaluated included "analysis that considers a wide range of different solutions or levels of stringency" (Ellig, 2016, p. 22). Evaluating more alternatives

should help agencies improve regulations in general and avoid many of the potential drawbacks of performance standards.

Once agencies have analyzed a wide range of alternatives, they should then select the alternative that provides the "biggest bang for the buck" (Ellig, 2013, p. 9). Executive Order 12866 instructs agencies to "select those approaches that maximize net benefits . . . unless a statute requires another regulatory approach" (Exec. Order No. 12866, 1993, p. 1). The Executive Order further explains that, while agencies should quantify the costs and benefits of regulations where feasible, the agencies should also include "qualitative measures of costs and benefits that are hard to quantify, but nevertheless essential to consider" (Exec. Order No. 12866, 1993, p. 1). In choosing the approach that maximizes net benefits, agencies should also include considerations such as distributive impacts and equity. This analysis should include potential disproportionate burdens of the standard on certain groups to help avoid issues of unfairness. Complementary statutes, such as the Regulatory Flexibility Act (5 U.S.C. 601–612), establish additional provisions that require federal agencies to consider the impact of rules on small businesses and limit disproportionate negative effects.[8] As with analyzing a wide range of alternatives, adhering to approaches that maximize net benefits will also help agencies improve regulations across the board. This includes choosing the best performance standard when this approach is appropriate and avoiding performance standards when this approach is likely to lead to poorer outcomes than some other alternative.

Additionally, retrospective analysis—while beneficial for all regulations—can act as a check on regulatory actions and help determine if performance standards have led to negative

[8] The US Small Business Administration monitors federal agencies' compliance with the Regulatory Flexibility Act. See the annual reports of the Chief Counsel for Advocacy on implementation of the Regulatory Flexibility Act, https://www.sba.gov/advocacy/regulatory-flexibility-act-annual-reports.

outcomes. The Carter administration first established retrospective review in Executive Order 12044 by instructing agencies to "periodically review their existing regulations to determine whether they are achieving the policy goals" (Exec. Order No. 12044, 1978, p. 3). Every president since has required retrospective analysis of regulations to some extent. The Obama administration expanded on previous requirements with Executive Order 13563 (Exec. Order No. 13563, 2011, p. 3822), and the Trump administration's Executive Order 13771 created incentives for agencies to look back at their existing stock of regulations by requiring that for every new significant regulatory action issued, agencies take two deregulatory actions (which would preferably include removing rules that are no longer useful) (Exec. Order No. 13771, 2017).

These executive orders emphasize the need to evaluate actual outcomes of regulations rather than rely on merely predictive analyses to understand how regulations affect people and the economy. The first step in meeting these requirements, however, comes in the initial regulatory analysis stage. Agencies must first establish a framework for retrospective review so that objective, accurate, and informative evaluations can be done. Unfortunately, the Mercatus Report Card found that only one of the 130 regulations reviewed "was accompanied by analysis that offered a reasonably complete framework for retrospective analysis of the regulation." Including this framework in the analysis stage of regulations would go a long way toward improving current and future regulations.

Systematic review of existing performance standards will also help agencies learn when and how performance standards lead to different outcomes. This information will better position agencies to avoid many of the potential drawbacks of performance standards because they will understand how to avoid those problems based on experience. Another benefit to increasing

retrospective review of regulations is that it will provide more information about the tradeoffs between performance and design standards. Researchers have argued in the past that empirical evidence on the differences between performance and design standards is limited (Coglianese, Nash, and Olmstead, 2003, p. 713). Systematic retrospective review will build the empirical evidence for researchers and agencies to better understand the effects of each approach and determine the likely outcomes of choosing one over the other. This will help to limit performance standards that may fail to meet theoretical expectations.

Taking these steps would help agencies improve regulations generally and alleviate many of the drawbacks of performance standards described in the previous section. However, agencies should keep in mind additional specific considerations as they evaluate and choose between different types of standards. These considerations should apply to all regulations but are of particular importance when considering performance standards. They will help further mitigate many of the potential downsides of performance standards. When crafting performance standards, agencies should do the following:

- **Set standards that are reasonable and attainable.** Technology-forcing regulations often come with high costs for the industry responsible for developing the new technology—particularly the smaller businesses in that industry. Evaluating various levels of stringency and comparing net benefits should help avoid unnecessary uses of technology-forcing regulations as well.
- **Focus the requirements on the ends, not the means.** While agencies should take into account the capabilities of current technology when setting standards, they should avoid using language or including requirements specific to individual technologies. Otherwise, agencies may set standards that are too narrow or are de facto design standards, which

diminish the benefits of performance standards by limiting flexibility and innovation. Focusing on the ends may also limit the potential costs of businesses "teaching to the test."

- **Make the requirements clear and simple.** Agencies should state the requirements of the standard clearly, so that regulated entities can easily understand what goal the regulation seeks to accomplish and what the entities must do to comply. In accordance with focusing on the ends, agencies should avoid either discussing steps for meeting the standard in the regulation or layering standard upon standard. These actions create a more complex environment for businesses. Agencies may provide some advice on specific compliance technologies or steps in guidance documents as long as the agency makes it clear to its own staff and the regulated industries that the guidance does not constitute a requirement.
- **Evaluate the costs and feasibility of measurement and testing in the analysis of alternatives.** In order to avoid performance standards with difficult-to-measure requirements or costly testing methodologies, agencies should include these considerations when evaluating alternatives. This should include costs to the regulated entities as well as to any governmental body responsible for conducting compliance tests.
- **Lay out a clear plan for compliance testing and enforcement.** Agencies should ensure that the regulation includes a detailed description of what must be tested, how and how often the tests must be conducted, who must conduct the tests, and what penalties regulated entities will face if they fail to meet the requirements. This information should be clear and complete enough that regulated parties do not face uncertainty regarding testing or enforcement.

- **Consider whether disproportionate effects are likely to occur and, if so, conduct distributional analysis.** Agencies should consider if and how a regulation might affect groups or businesses in different ways. The most common and important considerations are how a regulation might disproportionately harm small businesses or low-income households. However, agencies should also consider other disproportionate effects (e.g., a standard may require or favor one technology based on testing methodology). Agencies should try to limit any disproportionate effects of regulation when feasible and reasonable given estimated costs and benefits. This will reduce opportunities for favoritism.
- **Evaluate the likelihood and cost of fraud or evasive behavior.** This evaluation should inform the agency's decision between a performance and a design standard. When the likelihood or cost of fraud or evasive behavior is high, agencies should consider large penalties for misconduct.
- **Consider potential unintended consequences.** Agencies should thoroughly consider how individuals and businesses might make tradeoffs following a new regulation and how compliance with the regulation might lead to other outcomes. This includes, but is not limited to, health-health and risk-risk tradeoffs, businesses "teaching to the test," environmental consequences, uncertainty regarding the consequences of new technology, and other changes to incentives.

5. Examples of Shifting from Design to Performance Standards

We have discussed the benefits and drawbacks associated with performance standards as well as steps agencies should take to ensure effective implementation of new performance standards. However, modifying existing design standards to better model performance standards is not an easy task. This is especially true if statutory, cultural, or administrative

hurdles stand in the way. Overcoming statutory or cultural difficulties is beyond the purview of this paper, but these problems present opportunities for Congress, the president, or regulatory agencies to improve regulations by instituting changes that promote the use of performance standards when appropriate. On the more technical side, administrative difficulties such as structuring and restructuring standards effectively and estimating costs and benefits may stand in the way. Understanding how to overcome these difficulties will be useful both for agencies attempting to modify existing standards and for agencies attempting to structure and analyze potential new standards.

Agency economists must quantify the costs and benefits of new rules and changes to existing rules, and regulators will face the challenge of measuring the cost savings of moving from design standards to performance standards. A benefit of performance standards is that their success does not rely on the knowledge of regulators to predict technological innovation or new methods of compliance. This means that agencies will have to incorporate the potential of unknown cost savings from undiscovered innovations.

These measurement challenges are especially relevant as regulators seek to comply with the Trump administration's Executive Order 13771. The objective of Executive Order 13771 is to manage regulatory costs and reduce private expenditures associated with regulatory compliance. The executive order instructs that "for every one new regulation issued, at least two prior regulations be identified for elimination, and that the cost of planned regulations be prudently managed and controlled through a budgeting process" (Exec. Order No. 13771, 2017).[9] Implementing a form of regulatory budgeting necessitates comparing the costs of proposed rules with those of existing ones.

[9] See also the OMB guidance on implementing Exec. Order 13771, April 5, 2017, https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/M-17-21-OMB.pdf.

Depending on the specific rule, agencies may have to predict the likely outcomes of a completely new performance-based system (e.g., in an industry or environment where performance standards do not yet exist). In other cases, agencies can draw from comparable systems that are already operating in other sectors or countries. Furthermore, if agency officials are tasked with complying with a one-in-two-out requirement, they need a reliable way to produce benefit-cost analyses of regulations so existing rules can be "exchanged" for new ones. While there is no single approach for calculating cost savings, exploring examples of how federal agencies have adopted performance standards provides some insight. Agencies can also use the lessons from these examples when structuring and analyzing new regulations.

The Federal Aviation Administration

The FAA has replaced existing design standards with performance-based regulations, which "capture the safety intent of the earlier prescriptive regulations" (Federal Aviation Administration, 2017, p. 3). One agency advisory circular discussed using consensus standards to comply with regulatory requirements. In the circular, the FAA defines consensus standards as "industry developed standards the Administrator has accepted for use as a means of compliance to the . . . regulations" (Federal Aviation Administration, 2017, p. 2). Combined with performance standards that permit flexibility for regulated parties, consensus standards "clarify how safety objectives may be met by specific designs and technologies." These standards also state on the first page that "this [advisory circular] is not mandatory and does not constitute a regulation" (Federal Aviation Administration, 2017, p. 3). This combination of regulation and guidance helps regulated parties by providing descriptions of potential means of compliance without mandating technologies or processes.

A key benefit of the FAA's approach is that the means of compliance are adaptable over time. Industry-created standards are malleable and can adjust to changing market conditions and technological advancement. This approach also better accounts for decentralized knowledge about technologies and innovations. A limitation is that smaller or less-established industries might not develop effective or sufficient consensus standards. However, as they represent merely one means of compliance, consensus standards can be replaced or accompanied by other means of compliance. Even if consensus standards are more useful for well-established industries, they allow emerging industries to develop and utilize norms that align with safety objectives. The FAA also allows regulated entities to propose alternative means of compliance, giving firms the opportunity to suggest options beyond consensus standards.

The Federal Railroad Administration

The Federal Railroad Administration (FRA) is also reforming its regulatory approach by amending its passenger safety requirements to improve compatibility with advanced technologies like high-speed rail. While previous FRA regulations that deal with safety for passenger rail primarily rely on design standards, the agency is actively shifting toward performance standards so as not to preclude "the adoption of newer technologies or design innovation" (Federal Railroad Administration, Final RIA, 2018, p. 17). The agency's 2018 "Passenger Equipment Safety Standards; Standards for Alternative Compliance and High-Speed Trainsets" rule establishes alternative crashworthiness requirements for Tier I trainsets (which have speeds of up to 125 mph) to give industry actors more flexibility to apply new or emerging technologies; increases the maximum authorized speed for Tier II trainsets (speeds up to 150 mph) to 160 mph; and includes minimum safety standards for Tier III trainsets (speeds up to 220 mph) (see 83 Fed. Reg. 59182–59186). While the current regulatory

framework for Tier I safety compliance is prescriptive, the rule incorporates performance-based rules into its safety standards and creates new performance standards for Tier III trainsets (83 Fed. Reg. 59183–59184).

The agency predicts that the rule will generate substantial cost savings, specifically by ensuring that "existing and future alternative trainset designs can operate in the U.S. railroad environment on a widespread basis, beyond the constraints that have been imposed by FRA regulations" (83 Fed. Reg. 59183–59184). In particular, the rule avoids a "patchwork of waivers" for manufacturers and "allows U.S. trainsets to use technological advances for safety compliance purposes in a way that was previously restricted under the former regulations" (83 Fed. Reg. 59184). In addition, the rule seeks to provide minimum United States railroad safety requirements to determine "whether passenger equipment platforms designed to contemporary standards outside of the United States are safe for operation in the U.S. rail environment" (Federal Railroad Administration, Final RIA, 2018, p. 88).

The final rule represents a move toward technological and design neutrality, with alternative designs permitted as long as the minimum regulatory requirements are fulfilled (Federal Railroad Administration, Final RIA, 2018, p. 99). The FRA anticipates the rule will produce net regulatory cost savings between $438.8 million and $837.8 million when discounted at the 3 percent level and between $284.8 million and $541.9 million when discounted at the 7 percent level (Federal Railroad Administration, Final RIA, 2018, pp. 9–10). In particular, infrastructure-related cost savings are estimated to make up the majority of cost savings, which "will be generated by the ability of railroad operators to take advantage of a blended operating environment, avoiding costly new construction and maintenance of dedicated track and acquisition of new rights-of-way" (Federal Railroad Administration, Final RIA, 2018, p. 8).

One inherent challenge in estimating the benefits or costs resulting from the shift from design to performance standards is determining how regulated parties will respond, especially when factoring in technologies not currently used in the United States. In its regulatory impact analysis for the final rule, the FRA estimated that by tapping into advanced technologies available in international markets, significant benefits would accrue to trainset engineering. In the analysis, the agency explains, "Use of more developed technology will ultimately be reflected in lower rolling stock prices and a greater purchasing power in the domestic passenger rail sector and produce economies of scale in design and engineering" (Federal Railroad Administration, Final RIA, 2018, p. 70).[10]

The agency articulates two key reasons for the benefit. First, the performance-based nature of the new regulations would create more flexibility and allow firms to meet requirements in the most cost-effective way (Federal Railroad Administration, Final RIA, 2018, p. 70). Second, the rule would increase the extent of the market by permitting technologies that are prohibited under existing regulations. As the FRA notes, "Regulatory changes will unify and enlarge the U.S. market" by integrating rail technologies that are more advanced overseas (Federal Railroad Administration, Final RIA, 2018, p. 70). The agency predicts that establishing the proposed performance standards would lower prices in the US market, specifically with cost reductions in design and engineering as global suppliers bring more advanced engineering designs to the United States (Federal Railroad Administration, Final RIA, 2018, pp. 70–72).

While establishing performance standards does not guarantee cost savings, the greater flexibility for firms to innovate and utilize advanced technologies is a critical feature of performance-based regulation. Looking at what agencies have already done to estimate cost

[10] Rolling stock refers to movable transportation equipment, such as passenger train cars.

savings provides insight into the ways that other agencies can align performance standards with other reforms like regulatory budgeting.

6. Conclusion

Although performance standards have been touted as best practice in regulatory rulemaking since at least 1980, it is not uncommon for agencies to default to design standards, even when performance standards are likely to lead to better outcomes. Yet performance standards have many inherent advantages over design standards, such as flexibility for businesses and openness to innovation. Performance standards also come with additional risks and require more delicacy in their architecture. Nevertheless, many of the drawbacks of performance standards can be overcome, while the drawbacks of design standards (i.e., benefits of performance standards) are inherent to those standards. Many of the potential downsides of performance standards can be avoided if agencies follow the procedures outlined in Executive Order 12866 and Circular A-4 and follow the recommendations laid out above. Furthermore, agencies should learn from the actions and experiences of other agencies that have adopted policies more amenable to performance standards. The FAA and FRA are two recent examples of judicious efforts to embrace these sorts of policies.

However, in many circumstances, shortcomings in analysis and administrative difficulties are not the only things standing in the way of agencies adopting performance standards. Statutory requirements may limit the ability of agencies to choose the standard most appropriate in a given situation. Cultural or institutional aspects of agencies may also promote an affinity to design standards: risk aversion, path-dependent rulemaking processes, rewarding more regulation rather than better regulation, and so on. Where these problems exist, more creative solutions may be necessary at the presidential, congressional, or agency levels.

Nonetheless, the principles outlined in this paper should help agencies take a big step in the right direction. The gains from agencies embracing these principles will extend beyond the immediate cost savings of flexibility. A more adamant devotion to adopting performance standards when feasible and appropriate will have large implications for market structure in many industries and will promote innovation that will lead to compounding industry growth. It will also align the incentives of agencies and businesses so that we may achieve our societal goals faster and more efficiently.

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