

3 PRACTICAL TOOLS TO HELP REGULATORS DEVELOP BETTER LAWS AND POLICIES

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Regulators and policymakers are driving efforts to deliver the benefits of automated vehicles (AVs) to the public as soon as possible, while minimizing their potential challenges. However, there are still many open questions regarding the best approach to achieving this objective. Key stakeholders—including regulators, policymakers, industry, citizens, and academia—have not yet reached a consensus on the approaches regulators should take in developing robust public policies for the governance of AVs.

Understanding the types of regulatory challenges for AVs and using new practical tools or using traditional tools in a different way, would help with this problem of developing better AV policies and regulations.

This policy paper analyzes several categories of regulatory challenges surrounding AVs and introduces three practical tools (Legal Interfaces, Law Labs, and Structured Dialogues) that can be utilized by policymakers and regulators in developing effective AV policies.

THREE CURRENT LEGAL CHALLENGES OF AVs FOR POLICYMAKERS AND REGULATORS

In this section, we introduce three current legal challenges presented by automated vehicles (AVs). These challenges are shared among most regulatory frameworks. Although regulatory frameworks vary by country, region, or other jurisdiction, most of these frameworks share common elements in their approaches to structuring the traffic system and managing potential dysfunctions.

We can identify three elements that most regulatory frameworks share: technical parameters, functions, and high-level definitions.

Shared Elements of Regulatory Frameworks Governing Vehicles

Technical Parameters that affect and limit the operation of the technology, for example, speed limits, preference in roundabouts, turn on red light, etc.

Functions that provide a concrete output, for example, determining liability, necessary insurance, or privacy violations.

Definitions of high-level, strategic, abstract, or philosophical concepts that establish the foundation of the regulatory framework, for example, what the definition of a driver is, what a driver's nature is, and what it means "to be in control of the vehicle."

By thinking of AV regulatory frameworks as languages, we can draw an analogy to grammatical structures. The technical parameters, such as mandatory distance between vehicles, can be seen as operational elements, part of the syntactic element of the language; the high-level definitions or concepts can be understood as part of the semantics of the language, informing the context and meaning of other rules; and choices such as strict liability and negligence, for example, which both stem from the same root—liability—can be seen as the morphological elements of the lan-

guage. Accidents of the same issue, regulations liability root, have accidents that are different types of liability.

These elements (syntactic, semantic, and morphological) pose different challenges and require different actions by AV regulators. We now introduce three challenges related to each of the elements described.

1 LEGAL INTEROPERABILITY

Element: *parameters such as speed limits, minimum distance between vehicles, and minimum parking distance from a fire station exit.*

Challenge: *harmonizing legal operational requirements to avoid slowing down innovation and furthering unequal access to innovations.*

Different countries operate under traffic codes that often differ in their specifications or operational restrictions (i.e. speed limits or the minimum distance between vehicles). These distinctions among regulatory frameworks result in barriers that generate two main problems: (1) they may hinder innovation, since AV manufacturers must customize the technology to operate within the specific parameters of the traffic code of the jurisdiction the vehicles will operate in

(and must train the AI system accordingly); and (2) they inhibit equal access to innovation. Because the process of adapting AVs to comply with distinct regulatory regimes is complex and time consuming, manufacturers cannot easily export the technology to all countries and are forced to make choices about which markets to prioritize. As a result, some countries (likely those that are the most profitable for the industry) may gain access to the technology earlier, and adopt it more rapidly, than others.

In this respect, the lack of legal interoperability in operational requirements slows down innovation and technology transfer.

2 POLICY REGIMES

Element: *functions such as liability or privacy regimes.*

Challenge: *determining the policy and legal regimes (morphological items) that will deliver the benefits of AVs quickly while minimizing their risks.*

This category of challenges includes practical questions about legal approaches that are best-suited to address problems and which public policies will be most effective in mitigating the risks posed by AVs while harnessing the oppor-

tunities they offer (driver safety, environmental protection, better use of parking spaces, increased mobility, etc.). Specific questions may include: what liability or insurance regime would work best? What transportation policy would encourage shared mobility and better manage parking spaces? What personal data privacy policy should govern AVs?

3 GUIDING VALUES, CONCEPTS, AND PROCESSES

Element: *the definitions at the core of concepts about what it means to be a “driver” and the nature of being “in control” of a vehicle.*

Challenge: *deciding the big questions to build a foundation for generating a coherent regulatory framework.*

This category includes high-level concepts and abstract questions that should guide the broader approach taken by governments in regulating AVs. The adoption of AVs present overarching questions that touch upon diverse fields such as

philosophy, ethics, morality, law, public policy, management, and governance. Answers to these questions can and should inform the process of developing AV policy. Examples of potential strategic questions include: what values do we want to protect in the deployment of AVs? How can we respond to the difficult ethical questions AVs present to societies? Through which processes and on what basis? How will we define a “driver” in an autonomous system, and what is the nature of being “in control” of the vehicle?

TOOLS & POLICY RECOMMENDATIONS

In this section, we introduce three practical tools, and accompanying policy recommendations, for helping policymakers and regulators address the challenges posed by AVs: (1) *Legal Interfaces*, (2) *Law Labs*, and (3) *Structured Dialogues*. As we will see, each tool is particularly well-suited for a specific type of legal challenge. For example, *Legal Interfac-*

es would be useful for dealing with countries' differences about operational specifications in traffic codes but not for defining abstract, high-level concepts, such as the nature of the driver, where the *Structured Dialogues* technique could work better.

1 The “Legal Interfaces” Model: how to reduce legal interoperability barriers (Syntactic Level).

Regulators and policymakers are already aware of the importance of harmonizing regulations on innovation and technology, but this is not an easy task. Harmonization allows innovation to spread faster among countries, consequently transmitting their benefits to society more quickly. Additionally, harmonization would provide businesses in the industry with the freedom to direct more of their efforts towards technological innovation eliminating the burden of complying with disparate regulatory frameworks. Finally, harmonization would help to establish a sense of legal certainty and predictability. In contrast, a lack of harmonization may result in innovations appearing in countries that are expected to be more profitable or have looser regulations much earlier than elsewhere due to the cost of adapting the technology to each jurisdiction.

However, harmonization could be a very long and resource-intensive process; and not all countries may be willing to cede their power in this sphere by changing their regulations, which have been

informed by local values and criteria optimized for specific contexts.

Innovative tools and models that facilitate harmonization without requiring an actual change in the laws could help with this problem. Governments would not have to choose between entering a long, international harmonization process to adapt their laws or stifling innovation and international commerce.

The problem with traffic codes operational constraints

On a functional level, AVs need to abide by the traffic rules governing the jurisdiction that the vehicle is operating in. The AVs that are currently being developed are customized to work in a specific state and city under its traffic rules. If companies want to commercialize their vehicles in another jurisdiction, the systems must first be modified to the rules of that jurisdiction, a pro-

cess which may require a significant amount of time and resources.

We have conceived a tool, we referred to as the “Legal Interfaces” model, that could help reduce regulatory barriers to innovation. The effect of Legal Interfaces is to act as a mediator between regulations and technology. The technique can facilitate interoperability among some types of regulations without the need to actually modify them, thereby allowing each state to maintain their own main legal specificities while affording flexibility to fast-changing technologies like AVs.

How does the Legal Interfaces model work?

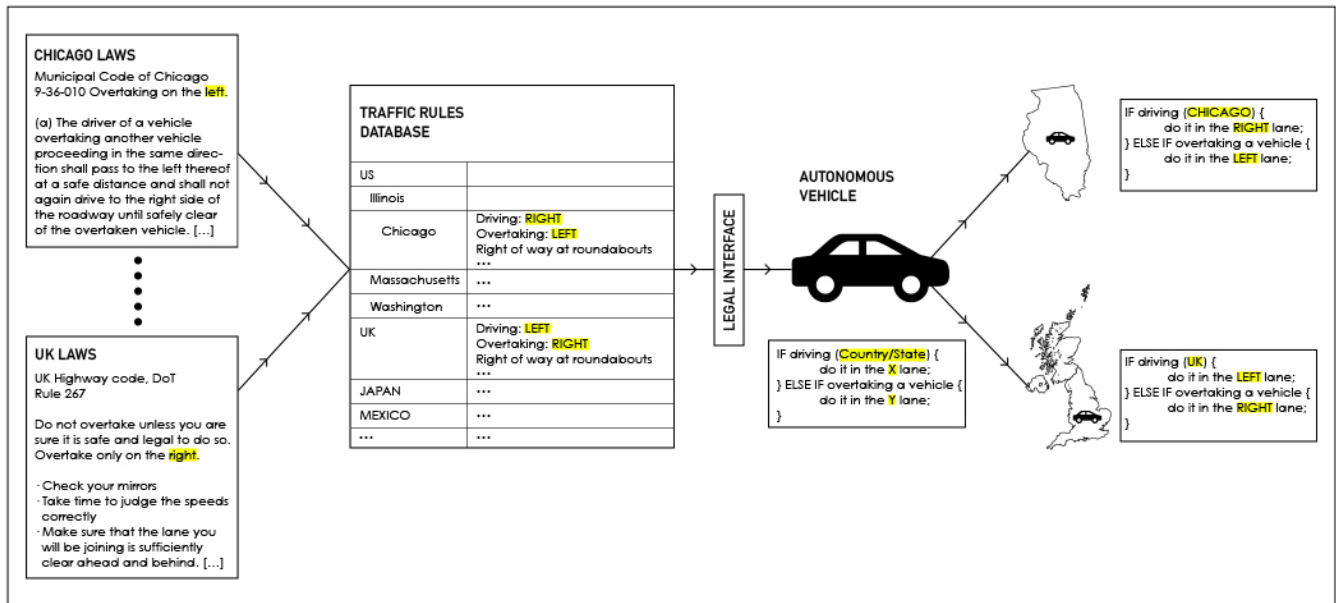
The Legal Interfaces model mediates between the legal language of regulation and the binary language used by computers. It can also work for technical or operational elements of regulations, such as speed limits or minimum required distance between vehicles.

At an international level, governments should work with industry to identify the key parameters of regulations that AVs need to operate in a hypothetical territory. In the AV context, these parameters would include, for example, speed limits, lane of driving, and rules of preference on crossings or for undertakings. Data and procedures are the two elements of regulations that are intertwined in the actual writing of codes and laws. With the Legal Interfaces model, governments would separate data from procedures, storing the data in a globally accessible database. A company could then visit the database, retrieve the data of the jurisdiction in which it seeks to

operate, and provide it to the AV, thereby allowing it to operate in that jurisdiction. The Legal Interfaces model will also help with the **problem of some laws containing terms that are too vague or ambiguous**. For instance, many traffic codes define the mandatory minimum distance between vehicles in terms of maintaining a “safe distance,” a term that may be clear for human drivers but too vague to be coded and help an AI system. Instead, terms such as “2 seconds” or “50 meters” would work better for an AI driver. The exercise of using this tool to parametrize regulations will help governments to look at regulations from the perspective of the machine. In this way, the tool provides an opportunity for governments to make regulations more precise, clarifying driving conventions and parameterizing legal concepts that would be useful for AI systems.

The following figure illustrates the idea of Legal Interfaces with the **example of how to overtake a vehicle in two different jurisdictions: Chicago and the United Kingdom**.

From laws in Chicago and the UK, we can extract the basic data (in yellow) that the AV needs to operate, separating these operational data from the procedures (no highlighted text). The datasets are then stored in a globally accessible traffic rules database. AV manufacturers would retrieve from this database the values of the jurisdiction in which they seek to operate and use these values to instantiate the variables of the AV coded procedures. This would allow the vehicle to easily change jurisdictions of operation by simply downloading the applicable dataset, thereby facilitating the legal interoperability among different jurisdictions.



One of the most exciting things about Legal Interfaces is that the model can be generalized and used for technologies other than AVs. For example, in the case of drones, the database could retain specific heights for flying and locations where flying is forbidden.

The Legal Interfaces model offers a new way for regulators and industry to interact with technologies and regulations, respectively. Writing laws with the Legal Interface model in mind would encourage regulators to consider how the technology operates. By facilitating the separation of data and procedures, it enables the creation of laws that can be better-utilized by technology. With the Legal Interfaces model, developers could generate their codes in a way that would make AVs responsive to the parameters that the jurisdiction provides, facilitating the flow of innovation.

Traditionally, laws have been criticized for lagging behind technology. This model offers an opportunity to improve the understanding between

laws and technology and to develop laws that can better adapt to changes in technology, helping to close the gap between regulators and technologists.

Possible next steps:

1. [Database] Agree on the organization/entity, for instance the International Telecommunications Union, that is best-positioned to manage the global database.
2. [Datasets] Establish a working group of regulators, industry representatives and other relevant stakeholder tasked with selecting the most useful variables to include in the database for the AVs.
3. [Implementation] Extract and clarify the values of regulations, which governments would introduce into the database, so that AV companies can download and use them when necessary.

2 Law Labs: Experimenting with different approaches to solve new challenges (Morphologic Level)

On a more tactical level, governments need to identify the most effective policy approaches for addressing AV challenges. In many cases, there may not be an established framework from which to act. For instance, regulators need to decide which liability regime would work better in a situation in which there is no human driving the vehicle (“autonomous vehicle,” SAE levels 4 and 5), when the driver is sharing driving responsibilities with the AI system (“semi-autonomous vehicle,” SAE levels 2 and 3), and when there is no data available to determine what went wrong (because, for example, the vehicle was destroyed in an accident). Just as governments may regulate the type and amount of insurance that AV manufacturers or operators are required to carry, they may similarly have to define the threshold at which an AV can be declared safe and able to operate on public roads.

To some extent, these types of questions are not new for regulators. Every technological innovation generates uncertainty that makes the policymaking process more complex. Legislators and other policymakers often lack the technical knowledge and expertise necessary to fully understand the impacts of a given technology.

Although these are not novel questions, AVs—as part of the AI paradigm—bring more complexity into play. Introducing fully AVs will mean substituting the term “human driver” for “AI system” in all applicable regulations (e.g. traffic, vehicle,

safety, insurance, business, employment). It will also mean reframing questions that were first asked in the 19th century with the introduction of the automobile.

How do “Law Labs” work?

Law Labs could be used to test different regulatory approaches to these questions and determine the best options for each situation.

The concept of Law Labs is similar to the concept of *regulatory sandboxes*.¹ Regulatory sandboxes are being used to test new models of innovation in closed, controlled environments (operating under temporary regulatory exemptions or allowances) that accelerate competition. Law Labs, instead, could be used to experiment with regulatory approaches for AVs in the same type of environment, providing policymakers with a mechanism to track challenges and progress.

A group of jurisdictions could develop a set of potential legal frameworks. Jurisdictions could then conduct tests using these legal frameworks, measure their impact, compare their results, and use the knowledge gleaned from these experiments to inform decisions that must be made under conditions of technological uncertainty. For example, a group of participant states can develop testing legal frameworks for different insurance, liability, and privacy models. Participant X could decide to impose a strict liability regime on

¹ Ivo Jenik & Kate Lauer, *Regulatory Sandboxes and Financial Inclusion* (2017); <http://www.cgap.org/sites/default/files/Working-Paper-Regulatory-Sandboxes-Oct-2017.pdf>

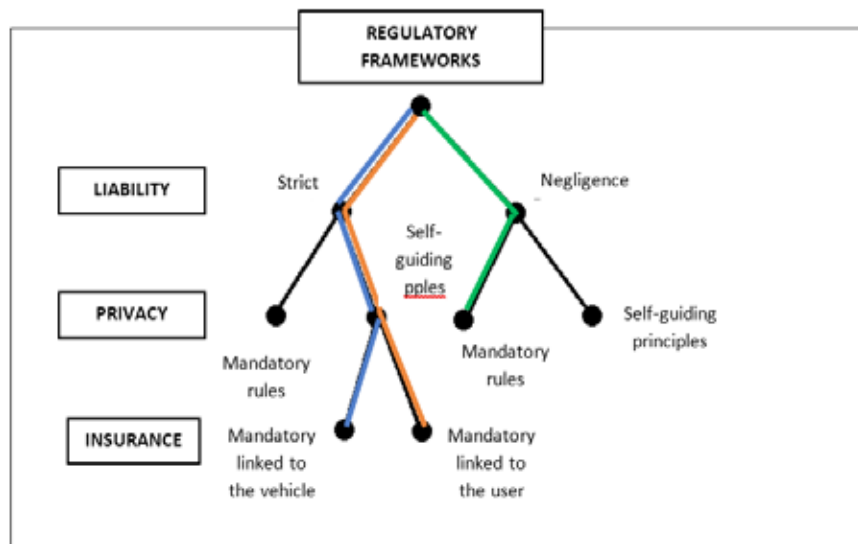
AVs and establish a list of privacy requirements that AV manufacturers must comply with before commercializing the vehicles. Participant Y could decide to impose, for instance, a refutable strict liability regime, and require AV manufacturers to only submit notice of their privacy policy. Participants X and Y could measure the impact of these regulatory choices, then share with each other what worked well, and what did not, and refine each framework based on this experience. Thus, Law Labs could help gather evidence about the impact of actual regulations and facilitate a more informed decision-making process. This idea has been proposed in the European Union for developing AV policy.

The different regulatory choices for each issue tested by the participating governments could be displayed in a tree graph, as showed in the next figure. The graph shows a global view of the competing regulatory approaches in a direct way and helps to keep track of the varying initiatives. In addition, each government that is part of the Law

Lab Initiative would report their successes and challenges so that everyone can learn from each other's experiences and iteratively refine their regulations.

Possible next steps:

1. [Issues] Determine the questions or issues (liability, insurance, privacy, and cybersecurity, for instance) that could be explored through Law Labs tests to provide the most value to policymakers.
2. [Implementation] Create a network of governments that would like to participate in the Law Labs Initiative. Each of their approaches to the issues (liability, insurance, privacy, etc.) will then become part of the shared tree graph. Governments will report on the results of their initiatives so that other participants can learn from one another and continue refining their regulatory framework in an iterative and agile process.



3 Structured Dialogues: Define Big Policy Questions and Engage in Problem-Solving (Semantic Level)

Finally, governments need to unite their efforts to find the best strategies related to the governance of AVs. This strategic level of action has two steps: first, policymakers can work to identify the key policy questions about the governance of AVs that need to be agreed upon; and second, establish Structured Dialogues with stakeholders, industry, and civil society to shape the most coordinated strategy at an international level.

International coordination concerning technology policies is important because it helps remove unnecessary burdens from innovation as well as allow the flow of innovative technologies among countries, enabling societies to enjoy the benefits of specific technologies in critical sectors such as health or education earlier.

The technique of Structured Dialogues is not new. It was originally designed in the early 1970s by *Aleco Christakis y John N. Warfield*². Structured Dialogues are especially useful for dealing with complex issues that involve many stakeholders such as youth policy cooperation,³ sustainable development,⁴ human rights,⁵ to advance the rule of law,⁶ culture,⁷ poverty,⁸ and security.⁹

Structured Dialogues could help to address the broad, strategic questions surrounding AVs and AI in general.

2 Yiannis Laouris, *Reengineering and Reinventing both Democracy and the Concept of Life in the Digital Era* in *The Onlife Manifesto: Being Human in a Hyperconnected Era*, at page 130 (2015) <https://books.google.com/books?id=Z3pqBQAAQBAJ&printsec=frontcover&dq=isbn:3319040936&hl=es&sa=X&ved=0ahUKewj1em-RidHaAhVDheAKHbWJBpoQ6AEIKDAA#v=onepage&q=structured%20dialogue&f=false>

3 European Commission Webpage on Youth: Supporting Youth Actions in Europe: https://ec.europa.eu/youth/policy/implementation/dialogue_en

4 United Nations Sustainable Development web portal: *Knowledge Platform*, General Assembly Structured Dialogues; <https://sustainabledevelopment.un.org/index.php?menu=1822>

5 See United Nations, *Follow-Up to the High Commissioner's Structured Dialogue on NGO-IFRC-UNHCR Partnership* (August 2013); <http://www.unhcr.org/573484967.pdf>

6 Delegation of the European Union to Bosnia and Herzegovina & European Union Special Representative to Bosnia and Herzegovina official website, *Structured Dialogues*; http://europa.ba/?page_id=553

7 Voices of Culture: Structured Dialogue between the European Commission and the cultural sector website; <http://www.goethe.de/ins/be/prj/voc/en/index.htm>

8 European Anti-Poverty Network website, *Structured Dialogues*; <https://www.eapn.eu/structured-dialogues/>

9 Permanent the Czech Republic to the United Nations, OSCE, and other International Organizations in Vienna webpage, *OSCE Structured Dialogues on the Current and Future Challenges and Risks to Security* (2017); https://www.mzv.cz/mission.vienna/en/latest/osce_structured_dialogue_on_the_current.html

How does the “Structured Dialogues” model work?

First step: identify the key policy questions

There are at least two main types of policy issues that governments need to consider in developing a governance strategy for AVs: content-oriented issues and process-oriented issues. **Content-oriented** issues include questions that address both how technology should be governed and how to govern the impacts of the technology:

Governing the technology: shaping the technology for the social good. The questions here would consider: (1) the high-level concepts (such as the nature of the driver and the nature of control of the vehicle) that need to be agreed upon and updated; (2) the values that need to be protected, including privacy, safety, security, human dignity, integrity, accessibility, and equality; and (3) the policy strategies necessary for shaping the technology to protect those values, for instance, using international standards, industry guidelines, or regulatory tools.

Governing the impacts of the technology: acting proactively instead of reactively. These questions would analyze the potential impacts of AVs on the economy, transportation systems, land management, environment, and society (in terms of equality, inclusion, employment, and self-development) and consider which public policies would be best for society.

Process-oriented questions refer to the institutions and procedures that would need to be put in place or remodeled to effectively govern AVs. For instance, which actors need to be involved in answering the ethical questions about AVs (e.g. software designers, manufacturers, governments,

users)? Through which processes and on what basis (e.g. utilitarian, non-discriminatory, democratic)?

Second step: establish structured and problem-solving-oriented dialogues

Once governments have agreed on a set of questions about AV governance, the next step would be to establish Structured Dialogues with stakeholders, industry, and civil society to come up with the best solutions. The more accepted any given answer is, the greater the likelihood that it will develop into a shared norm. A series of Structured Dialogues would help to shape the development of AVs and allow the technology to reach its full potential for benefiting society.

In order to be most effective, these series of dialogues need to be structured and problem-solving-oriented. Structuring dialogues will enable wide participation of the different stakeholders’ groups by providing clear guidelines and mechanisms to communicate. Orienting dialogues toward a problem-solving approach will facilitate getting concrete results and outputs that will help to move AV policies forward.

Finally, the resulting questions, plans of action, and strategies could be used as a case study for the application of AI. This could help to address the challenge of governing this horizontal technology that is revolutionizing the ways in which society and governments interact with technology and with each other, a phenomenon that the World Economic Forum has called the “Fourth Industrial Revolution.”¹⁰

¹⁰ World Economic Forum, *The Fourth Industrial Revolution: what it means, how to respond* (2016) <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>

Possible next steps:

1. [*Content-oriented issues*] At an initial stage, governments should individually review the content-oriented questions relevant to AVs. They should decide which values need to be embedded in the technology and try to predict the potential negative socioeconomic impacts of AVs.

Next, governments should share their lists of values and their research on the impacts of the technology to create a list of generally agreed-upon values that should be protected in developing policies to govern AVs.

Then, for each of the identified values and critical impacts, governments should consider the optimal course of action (national versus international action, industry standards, self-regulation, regulation, etc.).

2. [*Process-oriented issues*] For the process-oriented questions, governments should decide together which agency/organization would best serve as the main international body to coordinate and guide the big governance issues of AVs (or AI more generally) at an international level.

Secondly, governmental units in charge of managing AVs should connect with each other and the chosen agency, establishing a network of contacts that would allow agile dialogues to take place.

Then, the network of contacts should convene and propose the initial procedures for addressing the strategic questions surrounding the governance of AVs.

3. [*Structured Dialogues*] Finally, the chosen agency should organize Structured Dialogues with stakeholders, industry, and civil society to share the proposals and use the other participants' inputs to enrich the solutions found so far.

CONCLUSION

Autonomous vehicles are gaining the attention of industry, governments, academia, and civil society. AVs have the potential to produce many benefits for society, but the technology also poses new challenges. Governments need to develop proactive policies that generate positive feedback between technology and society, helping to shape the impact of technology to best benefit citizens while minimizing risks.

Understanding the types of regulatory challenges surrounding AVs and using diverse, practical tools to address them can help to develop better AV policies and regulations.

This policy paper introduced some practical tools that can be used by policymakers as they build a framework for the governance of AVs. The tools introduced in this paper (Legal Interfaces, Law Labs, and Structured Dialogues) each serve to address different problems. While Legal Interfaces can help to facilitate interoperability among operational regulations, Law Labs can help to determine the most appropriate regulatory regime. Finally, Structured Dialogues can help find answers to important strategic questions and define key abstract concepts. These tools would, hopefully, be generalized and used within other AI technologies, facilitating the integration of technology into society and allowing the world to enjoy its benefits.

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ADDITIONAL READINGS

A permalink to this paper can be found here:

<http://cyber.harvard.edu/publication/3-practical-tools-help-regulators-develop-better-laws-and-policies>

For further information about AVs and their technical challenges, threats and opportunities, and international trends in AV governance, regulators and policymakers can access the following complementary policy papers of the series:

[Five Technological Factors Regulators and Policymakers Need to Know](#), which presents the basics of AV technology and summarizes current policy discussions.

[A Smart Move? Twenty-Four Essentials of a SWOT Analysis Policymakers Need to Consider](#), which analyzes the most relevant strengths, weaknesses, opportunities, and threats (SWOT analysis) facing governments as they design comprehensive AV policy.

[What Governments Across the Globe Are Doing to Seize the Benefits of Autonomous Vehicles](#), which introduces some of the AV strategies and initiatives that other governments are employing to navigate the challenges of AVs and to facilitate reaching the full potential of AVs.