GOVERNING AI

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Artificial intelligence (AI) is increasingly pervasive and essential to everyday life, enabling apps and various smart devices to autonomous vehicles and medical devices. Yet along with the promise of an increasingly interconnected and responsive Internet of Everything, AI is ushering in a host of legal, social, economic, and cultural challenges. The variety of stakeholders involved – spanning governments, industries, and users around the world – presents unique opportunities and governance questions for how best to facilitate the safe and equitable development, deployment, and use of innovative AI applications. Regulators around the world at the state, national, and international levels are actively considering next steps in regulating this suite of technologies, but with little sense of how their efforts can build on and reinforce one another. This state of affairs points to the need for novel approaches to nested governance, particularly among leading AI powers including the United States, European Union, and China. This Article provides an overview of AI and the numerous challenges it presents with special attention being paid to autonomous vehicles, along with exploring the lessons to be learned from polycentric governance frameworks and how to apply such social science constructs to the world of AI.

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"People worry that computers will get too smart and take over the world, but the real problem is that they're too stupid and they've already taken over the world."[1]

INTRODUCTION

History was made in a Phoenix suburb during the winter of 2018—customers began paying for "robot rides" from Waymo, the self-driving car company that has emerged from Google's efforts.[2] Competing autonomous shuttle services such as May Mobility quickly followed suit,[3] as have major automobile manufacturers such as Ford, which has pledged to have a fully autonomous car available by 2021 in a bid to create a new industry that will be, according to some estimates, worth some $7 trillion to the global economy along with potentially saving thousands of lives.[4] But this is just the tip of the iceberg when considering the myriad poten-

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[1] PEDRO DOMINGOS, THE MASTER ALGORITHM: HOW THE QUEST FOR THE ULTIMATE LEARNING MACHINE WILL REMAKE OUR WORLD 286 (2015).

[2] *See* Alex Davies, *The Wired Guide to Self-Driving Cars*, WIRED (Dec. 13, 2018), https://www.wired.com/story/guide-self-driving-cars/.

[3] *Id.*

[4] *Id.*; *Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley* team, FORD MEDIA CENTER, https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html (Aug. 16, 2016).

tial impacts of the technology undergirding this historic transition—artificial intelligence (AI), and in particular machine learning (ML).[5] From revolutionizing medical devices,[6] to reducing energy use, to improving cybersecurity and even aiding in college admissions,[7] we seem to be on the cusp of a revolution—one that could have as profound an impact as the printing press, steam engine, or the Internet itself. However, we have only begun to ask fundamental questions about how this revolution should be governed so as to help ensure its numerous potential benefits while minimizing risks to consumers' health, safety, and privacy.

We are already seeing the consequences of weak and fragmented attempts to govern the various applications of AI and ML technologies. From well-publicized accidents involving autonomous vehicles,[8] to concerns over biased algorithms,[9] and even "deep fakes" used to spread disinformation,[10] the collective action problems involving AI are increasingly apparent and underscore the need for new methods to address the host of legal, social, economic, and cultural challenges that these technologies present. The variety of stakeholders involved—spanning governments, industries, and users around the world—presents unique governance questions and opportunities for how best to facilitate the safe and equitable development, deployment, and use of innovative AI and ML applications. Regulators around the world at the state, national, and international levels are actively considering next steps in regulating this suite of technologies, but with little sense of how their efforts can build on and reinforce one another. This state of affairs points to the need for novel approaches to AI governance, which so far have been

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5 *See, e.g.*, Bernard Marr, *What Is The Difference Between Artificial Intelligence And Machine Learning?*, FORBES (Dec. 6, 2016, 2:24 AM), https://www.forbes.com/sites/bernardmarr/2016/12/06/what-is-the-difference-between-artificial-intelligence-and-machine-learning/#69101912742b ("Artificial Intelligence is the broader concept of machines being able to carry out tasks in a way that we would consider "smart" [while] Machine Learning is a current application of AI based around the idea that we should really just be able to give machines access to data and let them learn for themselves.").

6 *See* Kristopher Sturgis, *How Artificial Intelligence Is Changing Medical Devices*, MDDI (May 17, 2018), https://www.mddionline.com/how-artificial-intelligence-changing-medical-devices.

7 Jayshree Pandya, *Troubling Trends Towards Artificial Intelligence Governance*, FORBES (Feb. 25, 2019, 6:53 PM), https://www.forbes.com/sites/cognitiveworld/2019/02/25/troubling-trends-towards-artificial-intelligence-governance/#127bd1325a56; *15 Business Applications for Artificial Intelligence And Machine Learning*, FORBES (Sept. 27, 2018, 8:00 AM), https://www.forbes.com/sites/forbestechcouncil/2018/09/27/15-business-applications-for-artificial-intelligence-and-machine-learning/#79148f12579f.

8 *See* Russell Brandom, *Self-Driving Cars are Headed Toward an AI Roadblock*, THE VERGE (July 3, 2018, 10:12 AM), https://www.theverge.com/2018/7/3/17530232/self-driving-ai-winter-full-autonomy-waymo-tesla-uber.

9 *See* Anjanette H. Raymond & Scott J. Shackelford, *Technology, Ethics and Access To Justice: Should An Algorithm Be Deciding Your Case?*, 35 MICH. J. INT'L L. 485, 522 (2014).

10 *See* Bobby Chesney & Danielle Citron, *Deep Fakes: A Looming Challenge for Privacy, Democracy, and National Security*, 107 CAL. L. REV. 1753, 1762 (2019).

underappreciated and scarcely attempted in the literature. Indeed, there has not yet been a single effort in a legal publication to unpack the benefits and drawbacks of polycentric governance as applied to AI, despite the fact that it has been successfully applied to a variety of related issue areas.[11]

Since it was first used in the 1951 book *The Logic of Liberty* by Professor Michael Polanyi, polycentric governance has become a widely discussed concept built by scholars from around the world, including Lon Fuller and Nobel Laureate Elinor Ostrom and Professor Vincent Ostrom, to name a few.[12] Although some confusion continues in the literature about the exact contours of the concept, in general it is an overlapping multidisciplinary, multi-level, multi-purpose, multi-functional, and multi-sectoral model[13] and, as such, "may be capable of striking a balance between centralized and fully decentralized or community-based governance."[14] It is noteworthy both for its breadth (given that it has been used to analyze everything from fishery management to orbital debris mitigation) as well as for the fact that it challenges orthodoxy, such as by demonstrating the benefits of self-organization and networking regulations "at multiple scales."[15] One key finding is that, often due to the existence of free-riders in a multipolar world, "a single governmental unit" or treaty regime is often incapable of managing "global collective action problems"[16] such as cyber-attacks. Instead, a polycentric approach can promote "flexibility across issues and adaptability over time"[17] by recognizing both the common but differentiated responsibili-

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11 *Cf.* Ryan Calo, *Artificial Intelligence Policy: A Primer and Roadmap*, 3 U. BOLOGNA L. REV. 180 (2018) (analyzing policy responses to AI challenges); Michael Guihot, Anne F. Matthew, & Nicolas P. Suzor, *Nudging Robots: Innovative Solutions to Regulate Artificial Intelligence*, 20 VAND. J. ENT. & TECH. L. 385, 414 (2017) (exploring the myriad challenges of governing AI systems).

12 MICHAEL POLANYI, THE LOGIC OF LIBERTY (Karl Mannheim ed. 1951).

13 Michael D. McGinnis, *An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework*, 39 POL'Y STUD. J. 169, 171 (2011), ("Polycentricity is a system of governance in which authorities from overlapping jurisdictions (or centers of authority) interact to determine the conditions under which these authorities, as well as the citizens subject to these jurisdictional units, are authorized to act as well as the constraints put upon their activities for public purposes.").

14 Keith Carlisle & Rebecca L. Gruby, *Polycentric Systems of Governance: A Theoretical Model for the Commons*, 47 POL'Y STUD. J. 927, 928 (2019).

15 *See* Elinor Ostrom, *Polycentric Systems as One Approach for Solving Collective-Action Problems* 1 (Ind. Univ. Workshop in Political Theory and Policy Analysis, Working Paper Series No. 08–6, 2008), http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/4417/W08-6_Ostrom_DLC.pdf?sequence=1.

16 Elinor Ostrom, *A Polycentric Approach for Coping with Climate Change* 35 (World Bank, Policy Research Working Paper No. 5095, 2009), http://www.iadb.org/intal/intalcdi/pe/2009/04268.pdf.

17 Robert O. Keohane & David G. Victor, *The Regime Complex for Climate Change* 9 PERSP. ON POL. 7, 15 (2011); *cf.* Julia Black, *Constructing and Contesting Legitimacy and Accountability in Polycentric Regulatory Regimes*, 2 REG. & GOVERNANCE 137, 157 (2008)

ties of public and private sector stakeholders in AI, which can generate positive network effects that could, in time, result in the emergence of a norm cascade improving AI governance.[18] Yet, these systems are also prone to certain "syndromes" that can lead to disfunction,[19] and even fragmentation, meaning that both the benefits and drawbacks of this approach must be critically assessed.

This Article provides an overview of the development of AI and the numerous challenges it presents with special attention being paid to healthcare, autonomous vehicles, and cybersecurity, focusing on lessons to be learned from polycentric governance frameworks. We argue that the hybrid governance structures to manage a range of AI applications may, in fact, be best case scenarios, but that the diversion between the major AI powers—namely the United States, China, and the European Union (rather particularly when it comes to AI regulation)—threatens the integrity of this system absent deeper coordination. The Article is structured as follows. Part I briefly summarizes the ML revolution, including coverage of the myriad benefits and potential economic, legal, and cultural impacts associated with AI. Part II summarizes the regulatory approaches to AI that have been tried to date at the international, federal, and state levels. Part III then introduces the field of polycentric governance, delving in particular to the dominant principles, layered governance structures, and frameworks that the field has generated, including the Ostrom Design Principles as well as references to the Institutional Analysis and Development (IAD), the Social-Ecological-Systems (SES), and the Governing Knowledge Commons (GKC) Frameworks in order to see how these may be useful in addressing governance gaps. Part IV then applies this approach through a case study focusing on autonomous vehicle governance between the AI powers. Part V finally summarizes implications for policymakers and managers. Ultimately, we find that polycentric governance is a helpful, though imperfect, lens through which to view AI governance, but that additional research is required to update these social science principles and frameworks to better fit the ML revolution.

(discussing the legitimacy of polycentric regimes, and arguing that "[a]ll regulatory regimes are polycentric to varying degrees").

18 *See generally* Martha Finnemore & Kathryn Sikkink, *International Norm Dynamics and Political Change*, 52 INT'L ORG. 887, 902–03 (1998). For a deeper dive on this topic, *see* Chapter 2 in SCOTT J. SHACKELFORD, MANAGING CYBER ATTACKS IN INTERNATIONAL LAW, BUSINESS, AND RELATIONS: IN SEARCH OF CYBER PEACE (2014).

19 *See* Michael D. McGinnis et al., *When is Polycentric Governance Sustainable?* (Ostrom Workshop Working Paper, Sept. 14, 2020), https://ostromworkshop.indiana.edu/pdf/seriespapers/2020fall-colloq/mcginnis.pdf.

I. WELCOME TO THE MACHINE LEARNING REVOLUTION

The term "artificial intelligence" was coined in a 1955 research proposal at Dartmouth College,[20] but the concept of AI predates the term itself. Myths and legends about intelligent beings created from inanimate objects date back to at least 2,700 years ago.[21] As explained by Stanford University research scholar Adrienne Mayor, "Our ability to imagine artificial intelligence goes back to the ancient times. Long before technological advances made self-moving devices possible, ideas about creating artificial life and robots were explored in ancient myths."[22] This is evident in ancient Greek literature dating back to Homer and Hesiod,[23] and is equally prevalent in science fiction today, such as *Frankenstein* in 1817,[24] the Tin Man in *The Wizard of Oz* in 1939,[25] or beloved androids C-3PO and R2-D2 in *Star Wars*.[26]

The modern field of AI, however, can be traced back to a 1956 workshop at Dartmouth College, where computer scientist John McCarthy brought together various experts in the field to explore the possibility of machines exhibiting or mimicking human intelligence.[27] Even before that, in 1950, renowned British computer scientist Alan Turing explored the mathematical possibilities of machines being able to think and act as humans.[28] Limited by computing power, inadequate amounts of data, and

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[20] *See* John McCarthy, Marvin L. Minsky, Nathaniel Rochester, & Claude E. Shannon, *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence*, 27 AI MAG. 12 (2006), https://www.aaai.org/ojs/index.php/aimagazine/article/view/1904/1802 ("[Researchers sought to] find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves.").

[21] Alex Shashkevich, *Stanford Researcher Examines Earliest Concepts of Artificial Intelligence, Robots in Ancient Myths*, STANFORD News (Feb. 28, 2019), https://news.stanford.edu/2019/02/28/ancient-myths-reveal-early-fantasies-artificial-life/.

[22] *Id.*

[23] *Id.* Two examples of the concept of artificial intelligence in Greek mythology are Talos and Pandora. Hephaestus, the Greek god of invention and blacksmithing, created both—Talos from bronze, and Pandora from clay. Zeus commissioned giant artificial bronze Talos to protect the island of Crete by throwing boulders at approaching threats. In the myth of Pandora, Zeus ordered Hephaestus to create Pandora as a punishment for humans and to wreak havoc on their lives. These myths date from 650 to 700 B.C.

[24] Stephen Cave & Kanta Dihal, *Ancient Dreams of Intelligent Machines: 3,000 Years of Robots*, NATURE (July 25, 2018), https://www.nature.com/articles/d41586-018-05773-y.

[25] Rockwell Anyoha, *The History of Artificial Intelligence*, HARV. SITN (Aug. 28, 2017), http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/.

[26] Nicholas Christakis, *How AI Will Rewire Us*, ATLANTIC (last visited Aug. 30, 2020, 8:16 AM), https://www.theatlantic.com/magazine/archive/2019/04/robots-human-relationships/583204/. This list is by no means exhaustive; these are only a few of the multitude of examples of AI or concepts of AI in literature and pop culture.

[27] STANFORD UNIV., *Artificial Intelligence and Life in 2030: One Hundred Year Study on Artificial Intelligence*, STAN. UNIV. 50 (2016), https://ai100.stanford.edu/sites/g/files/sbiybj9861/f/ai100report10032016fnl_singles.pdf.

[28] *See* A. M. Turing, *Computing Machinery and Intelligence*, 49 MIND 433, 441 (1950), https://www.csee.umbc.edu/courses/471/papers/turing.pdf ("Can machines think?") [*hereinafter* Turing, *One Hundred Year AI Study*]. The paper goes on to present the Imitation Game and

lack of funding, AI did not achieve substantial breakthroughs until there were significant changes to these factors over the past decade.[29] The remainder of this part will provide a brief overview of the field of AI today, its application across various sectors, and its multitude of potential benefits before going on to explain some of the challenges and concerns surrounding its widespread deployment.

A. Defining Artificial Intelligence

The authors of Stanford University's *One Hundred Year Study on Artificial Intelligence* describe artificial intelligence as a "[s]cience and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their nervous systems and bodies to sense, learn, reason, and take action."[30] Defining "artificial intelligence," however, is a more difficult task due to a general lack of agreement about the definition of what it means for something to be intelligent.[31] Another possible explanation behind the difficulty of defining AI is the fact that "[f]rom a technical perspective, [AI] is not a single technology, but rather a set of techniques and sub-disciplines ranging from areas such as speech recognition and computer vision to attention and memory, to name just a few."[32] Some researchers suggest that the absence of a universal definition of AI has allowed the field to flourish,[33] while others note that practical definitions may more appropriately state

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a measure for intelligence still referred to as the Turing Test. "Restated in modern terms, the 'Turing Test' puts a human judge in a text-based chat room with either another person or a computer. The human judge can interrogate the other party and carry on a conversation, and then the judge is asked to guess whether the other party is a person or a computer. If a computer can consistently fool human judges in this game, then the computer is deemed to be exhibiting intelligence." *Preparing for the Future of Artificial Intelligence*, NAT'L SCI. & TECH. COUNCIL COMM. ON TECH. at 5, n.4 (Oct. 2016), https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf.

29 *See* David Bollier, *Artificial Intelligence, The Great Disruptor: Coming to Terms with AI-Driven Markets, Governance, and Life*, ASPEN INST., at 3 (2018), http://csreports.aspeninstitute.org/documents/AI2017.pdf (identifying the three primary drivers of AI growth in today's market as "dataset sizes, Moore's law [computing efficiency], and demand.").

30 STANFORD UNIV., *supra* note 27, at 4.

31 JACOB TURNER, ROBOT RULES: REGULATING ARTIFICIAL INTELLIGENCE 7 (2019); *See* JERRY KAPLAN, ARTIFICIAL INTELLIGENCE: WHAT EVERYONE NEEDS TO KNOW 1 (2016) (noting that defining AI is "an easy question to ask but a hard one to answer" due to "little agreement about what intelligence is.").

32 Urs Gasser & Virgilio A.F. Almeida, *A Layered Model for AI Governance*, 21 IEEE INTERNET COMPUTING 58, 59 (2017).

33 STANFORD UNIV., *supra* note 27, at 12 ("Curiously, the lack of a precise, universally accepted definition of AI probably has helped the field to grow, blossom, and advance at an ever-accelerating pace. Practitioners, researchers, and developers of AI are instead guided by a rough sense of direction and an imperative to 'get on with it.'").

the goals of intelligence – either to achieve human-like characteristics or to behave rationally.[34]

While agreeing upon a universally accepted definition of AI has not been critical for advancements in the field, it will be an essential part of regulating or attempting to govern AI. For the purposes of this Article, we will utilize the definition of AI provided by Nils J. Nilsson in *The Quest for Artificial Intelligence*: "[A]rtificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."[35] This definition is broad enough to capture the wide array of computational technologies and applications enabled by artificial intelligence, while narrow enough to differentiate AI from big data or other analytics. It also goes beyond defining AI by a desire to achieve human-like characteristics, recognizing that AI can surpass human performance in certain tasks, and approach others from a distinct perspective.

Within the broad scope of AI, there are two commonly recognized types: narrow AI and general AI, also called weak and strong AI, respectively. Narrow AI is the type we often think of today, where machines or algorithms are designed to perform a specific task or a set of specific tasks.[36] Narrow AI influences much of our daily life, "[f]rom using a virtual personal assistant to organise our working day, to travelling in a self-driving vehicle, to our phones suggesting songs or restaurants that we might like."[37] By contrast, artificial general intelligence refers to sys-

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[34] For an exploration of various definitions of AI and their implications, *see* Bernard Marr, *The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance*, FORBES (Feb. 14, 2018, 1:27 AM), https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#48d0f5464f5d ("[W]e're not all operating from the same definition of the term and while the foundation is generally the same, the focus of artificial intelligence shifts depending on the entity that provides the definition."); TURNER, *supra* note 31, at 16 ("Artificial intelligence is the ability of a non-natural entity to make choices by an evaluative process."); NILS J. NILSSON, THE QUEST FOR ARTIFICIAL INTELLIGENCE: A HISTORY OF IDEAS AND ACHIEVEMENTS xiii (2010) ("[A]rtificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."); ENGLISH OXFORD LIVING DICTIONARIES, https://en.oxforddictionaries.com/definition/artificial_intelligence (last visited Sept. 24, 2019) (defining artificial intelligence as "the theory and development of computer systems to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.").

[35] NILSSON, *supra* note 34, at xiii.

[36] Narrow AI is the technology underpinning various "commercial services such as trip planning, shopper recommendation systems, and ad targeting," and it is "finding important applications medical diagnosis, education, and scientific research." *Preparing for the Future of Artificial Intelligence*, *supra* note 28, at 7.

[37] ARTIFICIAL INTELLIGENCE FOR EUROPE, COMM. FROM THE COMM'N TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL

tems that exhibit intelligent behavior across a broad range of cognitive tasks, such as the AI imagined in science fiction.[38] Experts disagree on when science will achieve general AI, though a "[b]road chasm seems to separate today's Narrow AI from the much more difficult challenge of General AI."[39] As discussed throughout this Article, "AI" refers to both narrow and general AI.[40]

B. Technical Approaches to AI

Numerous technologies exist under the broad umbrella of AI, sometimes referred to as technical approaches to AI. These include machine learning (ML), computer vision, natural language processing (NLP), deep learning, and robotics, among others. Often, these technologies require large amounts of data in order to work efficiently and appropriately in their respective environments.[41] The most prevalent technology among today's advancements in AI is machine learning, which has enabled a host of developments across a multitude of technologies, sectors, and beneficiaries.[42] AI and ML are often used interchangeably, but ML is more accurately described as a method to realize AI. As explained by the United Kingdom's Information Commissioner's Office: "AI can be seen as a key to unlocking the value of big data; and machine learning is one of the technical mechanisms that underpins and facilitates AI."[43] ML uses statistical techniques that enable an algorithm to improve upon its performance based on outcomes and perceived inputs. Therefore, ML can be defined as "[t]he science of getting computers to act without being

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COMM. AND THE COMM. OF THE REGIONS., COM (2018) 237 final, at 1, https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-237-F1-EN-MAIN-PART-1.PDF.

38 *See* Iyad Rahwan et al., *Machine Behaviour*, 568 NATURE 477 (2019).

39 *Preparing for the Future of Artificial Intelligence*, *supra* note 28, at 7.

40 Though regulation today will likely focus on narrow AI (either sector-specific regulation or application-specific regulation), solutions to AI governance would be remiss to ignore the future prospect of general AI. Whether general AI is achieved in 2030 or beyond, it is the direction of AI research today, and AI governance could play a vital role in guiding its future development and deployment. For a different perspective, s*ee Preparing for the Future of Artificial Intelligence*, *supra* note 28, at 8, where the NSTC Committee on Technology argues that "[l]ong-term concerns about super-intelligent General AI should have little impact on current policy," but that "[p]ractitioners of AI in government and business should approach advances with appropriate consideration of the long-term societal and ethical questions. . . ."

41 The large data requirement is often considered by trends associated with big data are credited with bringing advancements in AI as well. "[I]ncreased data availability, storage, and processing power" are considered instrumental to the "rapid innovation and accomplishments in AI in recent years." U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-18-644T, ARTIFICIAL INTELLIGENCE: EMERGING OPPORTUNITIES, CHALLENGES, AND IMPLICATIONS FOR POLICY RESEARCH (2018).

42 INFO. COMM'N OFF., BIG DATA, ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DATA PROTECTION 9 https://ico.org.uk/media/for-organisations/documents/2013559/big-data-ai-ml-and-data-protection.pdf.

43 *Id.* at 8.

explicitly programed,"[44] and the technology is "[s]o pervasive today that you probably use it dozens of times a day without knowing it."[45]

Machine learning is the technology underpinning many of the techniques to achieve AI. Reinforcement learning, for example, "shifts the focus [of machine learning] to decision-making, and is a technology that will help AI to advance more deeply into the realm of learning about and executing actions in the real world."[46] Reinforcement learning is the technology behind the AlphaGo AI, for example, which defeated the human Go champion,[47] as well as Cue the "basketball bot" that has perfect accuracy shooting a basketball and recently set a Guinness World Record for successfully making 2,020 consecutive free throws.[48]

Deep learning is another type of ML that "uses structures loosely inspired by the human brain, consisting of a set of units (or 'neurons')."[49] Researchers have been studying deep learning since the 1960s, but advancements were largely impractical without the vast amount of data available today.[50] Recent advancements in neural networks have helped to create some of the most impressive achievements in AI, contributing to self-driving cars, medical image analysis, and language translation.[51] Deep learning advancements have provided new life to research in other areas of AI, especially computer vision and natural language processing.[52]

Computer vision enables machines to recognize, compare, identify patterns amongst, and draw conclusions about images—often with greater acuity and accuracy than human eyes.[53] This technology has ben-

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44 *Machine Learning*, Coursera, https://www.coursera.org/learn/machine-learning?action=enroll (last visited Sept. 27, 2019).

45 *Id.*

46 STANFORD UNIV., *supra* note 27, at 15.

47 *Id.*

48 Luke Dormehl, *Swish! Toyota's Basketball Bot earns a Guinness Record with 2,020 Perfect Throws*, DIGITAL TRENDS (June 25, 2019), https://www.digitaltrends.com/cool-tech/guinness-record-basketball-robot/. The number of perfect free throws – 2,020 – was in honor of the 2020 Olympics, which will be held in Japan – the same country where Toyota built and trained Cue. *Id.*

49 *Preparing for the Future of Artificial Intelligence*, *supra* note 28, at 9. Artificial neural networks are a brain-inspired concept that attempts to replicate the way humans learn. Neural networks rely on large amounts of input data to find patterns within data and create useful output layers of data. "For a basic idea of how a deep learning neural network learns, imagine a factory line. After the raw materials (the data set) are input, they are then passed down the conveyer belt, with each subsequent stop or layer extracting a different set of high-level features." Luke Dormehl, *What Is an Artificial Neural Network? Here's Everything You Need to Know*, DIGITAL TRENDS (Jan. 6, 2019), https://www.digitaltrends.com/cool-tech/what-is-an-artificial-neural-network/.

50 Keith D. Foote, *A Brief History of Deep Learning*, DATAVERSITY (Feb. 7, 2017), https://www.dataversity.net/a-brief-history-of-machine-learning/.

51 STANFORD UNIV., *supra* note 27, at 8–9, 20, 27.

52 *Id.* at 14–15.

53 *Id.* at 4.

efited the healthcare industry in a variety of ways, including, for example, assessing chest x-rays to diagnose pneumonia and mapping the motor cortex to aid in identification of neurological diseases.[54] Computer vision has also found a place in entertainment and sports, as it can be useful to improve player safety, augment human officiating, assist in training, and overall improve player experiences.[55] It is the technology behind facial recognition software, applications to help visually-impaired individuals better engage with their surroundings,[56] and other technologies that rely on image recognition and analysis.

Natural language processing, as the name suggests, involves a machine interacting with real-time dialogue. NLP enables digital assistants such as Amazon's Alexa or Apple's Siri, as well as real-time translation between languages, also referred to as natural language translation (NLT).[57] Google Translate helps 500-million people understand more than 100 languages on a daily basis.[58] This language translation has recently taken strides in accuracy as a result of more training data.[59] NLP technologies are often the first line of customer service interactions, and the use of chatbots is expected to expand, with estimates of up to 85

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54 Jennifer Bresnick, *Top 5 Use Cases for Artificial Intelligence in Medical Imaging*, HEALTH IT ANALYTICS (Oct. 30, 2018), https://healthitanalytics.com/news/top-5-use-cases-for-artificial-intelligence-in-medical-imaging.

55 Charlotte Edmond, *This AI Just Invented a New Sport*, WORLD ECON. F. (Apr. 30, 2019), https://www.weforum.org/agenda/2019/04/artificial-intelligence-invented-sport-speedball/. Not only is AI transforming the sports we watch today (monitoring NASCAR races for faults affecting safety by using deep learning and helping coaches and trainers monitor player performance), but AI is also capable of creating rules for new sports – such as Speedgate, a sport created by an AI using combinations of rules from soccer, croquet, and rugby. *Id.*

56 Kyle Wiggers, *Here Are the Ways AI Is Helping to Improve Accessibility*, VENTUREBEAT (May 17, 2018, 12:53 PM), https://venturebeat.com/2018/05/17/here-are-the-ways-ai-is-helping-to-improve-accessibility/ (noting the benefits to the blind and visually-impaired provided by screen-reading programs, photograph classification, smart glasses, and more).

57 *See, e.g.*, Ronak Vijay, *A Gentle Introduction to Natural Language Processing*, TOWARDS DATA SCI. (June 29, 2019), https://towardsdatascience.com/a-gentle-introduction-to-natural-language-processing-e716ed3c0863?gi=768262956aa1.

58 Bernard Marr, *5 Amazing Examples of Natural Language Processing (NLP) In Practice*, FORBES (June 3, 2019, 12:23 AM), https://www.forbes.com/sites/bernardmarr/2019/06/03/5-amazing-examples-of-natural-language-processing-nlp-in-practice/#23e7b1981b30.

59 While large training data sets have helped improve translations dramatically, some NLP processes are being deployed that rely on less data – or at least less intensive data. For example, typical AI translators are trained on two identical texts in two different languages, requiring accurate human translators for the training data. The training data sets for languages used frequently in news, social media, and entertainment are more readily available than low-resource languages. Researchers at Facebook set out to change this trend, hoping to provide translation to their customers in less common languages. Their research findings suggest a way to translate between English and other languages (such as Urdu) by having access to different texts in both languages, without accurate translators. Sam Shead, *Facebook Develops New AI Technique for Language Translation*, FORBES (Aug. 31, 2018, 11:00 AM), https://www.forbes.com/sites/samshead/2018/08/31/facebook-develops-new-ai-technique-for-language-translation/#639307f62f71.

percent of customer interactions taking place with AI by next year.[60] The usefulness of this technology, particularly when combined with other technologies such as speech recognition, extends to a wide array of applications. NLP can assist teachers or testing centers with grading exams,[61] help news organizations generate articles (in various languages) more rapidly,[62] or synthesize large documents such as legal documents or user manuals to improve their accessibility for the average person.[63]

While ML, deep learning, computer vision, and NLP are currently the largest subsets and trends within AI, other research trends include robotics and robotic navigation, collaborative systems to augment human intelligence, algorithmic game theory, and how to successfully utilize the Internet of Things (IoT).[64] In each emerging technology or area of research, it is important to highlight the potential for collaboration between humans and AI. As has been argued: "While AI is often perceived as systems acting autonomously, as is the case with home robotics or self-driving vehicles, most practical applications of AI augment human intelligence, serving as helpful resources in various professions and automating routine tasks."[65] AI can be useful for assisting in various decision-making settings, whether to manage resources, increase workplace safety, support human resources, or suggest diagnoses and treatments in medicine. Some scholars have estimated that 20 percent of workers will collaborate with an AI as part of their everyday job function by 2022.[66]

C. Applications and Benefits of AI

The recent developments and future promises of AI technologies provide myriad benefits that span a multitude of interested parties, industries, and sectors. The lofty future that AI could provide has been recognized by businesses, governments, and individuals; and with good reason. As noted by the European Commission's Independent High-Level Expert Group (HLEG) on AI, "AI is not an end in itself, but rather a promising means to increase human flourishing, thereby enhancing in-

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60 Marr, *supra* note 58.

61 *Automated Scoring and Natural Language Processing*, EDUC. TESTING SERV., https://www.ets.org/research/topics/as_nlp (last visited Sept. 27, 2019).

62 *Will AI Save Journalism — or Kill It?*, KNOWLEDGE@WHARTON (Apr. 9, 2019), https://knowledge.wharton.upenn.edu/article/ai-in-journalism/.

63 Marr, *supra* note 58.

64 *See, e.g.*, Scott J. Shackelford et al., *When Toasters Attack: A Polycentric Approach to Enhancing the 'Security of Things'*, 2017 U. ILL. L. REV. 415, 415–16 (2017).

65 Fred H. Cate & Rachel Dockery, *Artificial Intelligence and Data Protection: Observations on a Growing Conflict*, 11 SEOUL NAT'L. U. J. L. & ECON. REG. 107, 111 (2018).

66 Jeanne Meister, *AI Plus Human Intelligence is The Future of Work*, FORBES (Jan. 11, 2018, 10:46 AM), https://www.forbes.com/sites/jeannemeister/2018/01/11/ai-plus-human-intelligence-is-the-future-of-work/#452c0e232bba.

dividual and societal well-being and the common good, as well as bringing progress and innovation."[67] Some have even argued that, like cybersecurity,[68] AI will become an increasingly important component of sustainable development.[69] Similarly, the Norwegian Data Protection Authority highlighted AI's potential in its report on Artificial Intelligence and Privacy: "The development of AI has made some major advances in recent years and its potential appears to be promising: a better and more efficient public sector, new methods of climate and environmental protection, a safer society, and perhaps even a cure for cancer."[70] This section will provide an overview of some key advantages enabled by AI, as well as a brief but nonexclusive catalogue of the sectors benefiting from AI's deployment. We then balance this discussion with an examination of the downsides and challenges posed by various AI applications, which in turn drive the regulatory and governance discussions of Parts III–V.

Often, for users of AI, the most tangible benefits derived from AI adoption are as simple as speed, convenience, or accuracy. For individuals, AI recommendations for songs, movies, products, or traffic routes provide efficiency and convenience to improve daily routines.[71] For organizations, utilizing AI technologies can provide efficiencies and speed in resource and personnel management, employee performance monitoring, and customer service management.[72] These narrow AI applications providing daily conveniences have allowed AI technologies to become an integral part of everyday life.

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67 *Ethics Guidelines for Trustworthy AI*, HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE (Apr. 8, 2019), at 4 [hereinafter *HLEG AI Ethics Guidelines*].

68 *See* Scott J. Shackelford, Timothy L. Fort, & Danuvasin Charoen, *Sustainable Cybersecurity: Applying Lessons from the Green Movement to Managing Cyber Attacks*, 2016 U. ILL. L. REV. 1995, 1995–96 (2016).

69 *See* Michael Chui, Rita Chung, & Ashley van Heteren, *Using AI to help achieve Sustainable Development Goals*, U.N. DEV. PROGRAMME (Jan. 21, 2019), https://www.undp.org/content/undp/en/home/blog/2019/Using_AI_to_help_achieve_Sustainable_Development_Goals.html; Andrew Ware, *Does AI Present the Potential to Mitigate Resource Scarcity?*, CRASSH (Dec. 7, 2017), http://www.crassh.cam.ac.uk/blog/post/does-ai-present-the-potential-to-mitigate-resource-scarcity (making the case that AI can address resource scarcity by increasing trustworthiness, including "reliability, competency, and honesty.").

70 *Artificial Intelligence and Privacy*, NORWEGIAN DATA PROTECTION AUTHORITY (Jan. 2018), at 5 [hereinafter *NDPA AI and Privacy*].

71 Rhonda Bradley, *16 Examples of Artificial Intelligence (AI) in Your Everyday Life*, THE MANIFEST (Sept. 26, 2018), https://themanifest.com/development/16-examples-artificial-intelligence-ai-your-everyday-life.

72 *See, e.g.*, *The Workplace of the Future*, ECONOMIST (Mar. 28, 2018), https://www.economist.com/leaders/2018/03/28/the-workplace-of-the-future ("In 2017 companies spent around $22bn on AI-related mergers and acquisitions, about 26 times more than in 2015.").

Beyond the basic benefits provided by improving everyday convenience, AI provides a multitude of additional benefits to developers, governments, and users. The McKinsey Global Institute, for example, has estimated that the economic value of "applying AI to marketing, sales and supply chains" could add up to some $2.7 trillion by the 2030s.[73]

To harness this potential, more than thirty nations have developed or are developing national AI strategies—many of them since 2017.[74] Governments perceive AI as a key component of global influence, and for good reason. According to a 2017 study by PricewaterhouseCoopers (PwC), AI is expected to contribute $15.7 trillion to the global economy by 2030, constituting a 14 percent increase in global GDP and more than the 2017 output of China and India combined.[75] The "value of AI enhancing and augmenting what enterprises can do" is enormous, and may even "be larger than automation."[76] The estimated growth spans across

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73 *Id.*

74 The countries with a national AI strategy are geographically, politically, and economically diverse. Some of these plans focus only on research and development to realize the potential of AI, while others are more comprehensive governance plans. For a few examples of the variety of national AI strategies, see New Generation of Artificial Intelligence Development Plan, (promulgated by the St. Council, effective July 8, 2017) https://flia.org/wp-content/uploads/2017/07/A-New-Generation-of-Artificial-Intelligence-Development-Plan-1.pdf (China's AI Strategy); EMMA MARTINHO-TRUSWELL, HANNAH MILLER, ISAK NTI ASARE, ANDRÉ PETHERAM, RICHARD STIRLING, ET AL., TOWARDS AN AI STRATEGY IN MEXICO: HARNESSING THE AI REVOLUTION (June 2018), http://go.wizeline.com/rs/571-SRN-279/images/Towards-an-AI-strategy-in-Mexico.pdf (Mexico's AI Strategy); NITI AAYOG, NATIONAL STRATEGY FOR ARTIFICIAL INTELLIGENCE (June 2018), https://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf (India's AI strategy); NAT'L SCI. & TECH. COUNCIL COMMITTEE ON ARTIFICIAL INTELLIGENCE, THE NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT STRATEGIC PLAN: 2019 UPDATE (June 2019), https://www.whitehouse.gov/wp-content/uploads/2019/06/National-AI-Research-and-Development-Strategic-Plan-2019-Update-June-2019.pdf (United States' AI Strategy); QATAR CENTER FOR ARTIFICIAL INTELLIGENCE, NATIONAL ARTIFICIAL INTELLIGENCE STRATEGY FOR QATAR (Jan. 30, 2019), https://qcai.qcri.org/wp-content/uploads/2019/02/National_AI_Strategy_for_Qatar-Blueprint_30Jan2019.pdf (Qatar's AI Strategy). A common trend is for countries to develop an AI Task Force or related entity prior to the development and publication of the official strategy. Brazil, Estonia, Finland, Kenya, Sri Lanka, Tunisia, and several other nations currently have such task forces working on national AI strategies. *See also* THOMAS A. CAMPBELL, ARTIFICIAL INTELLIGENCE: AN OVERVIEW OF STATE INITIATIVES (Aug. 18, 2019), https://www.futuregrasp.com/artificial-intelligence-an-overview-of-state-initiatives (describing the AI initiatives—both formal and informal—of 41 nations).

75 *AI to Drive GDP Gains of $15.7 Trillion with Productivity, Personalisation Improvements*, PRICEWATERHOUSECOOPERS (June 27, 2017), https://www.pwc.com/gx/en/news-room/press-releases/2017/ai-to-drive-gdp-gains-of-15_7-trillion-with-productivity-personalisation-improvements.html.

76 *Id.* (quoting Anand Rao, Global Leader of AI at PwC).

all regions of the world.[77] Both governments and businesses are looking to emerge as leaders in a field with sky-high economic hopes.[78]

One of AI's unique attributes, and one of the reasons some believe it is launching society into the Fourth Industrial Revolution,[79] is its widespread application to a variety of sectors. AI technologies offer benefits in sectors ranging from health and medicine, automotive, transportation, marketing and retail, employment, and financial services, as well as less obvious sectors like agriculture, arts, cybersecurity, and education.[80] While this Article will highlight some of the benefits and drawbacks of applying AI technologies in the transportation context, it is important to place that discussion in context by also investigating healthcare and cybersecurity.

1. Health & Medicine

The healthcare industry is poised to reap some of the greatest benefits of AI adoption. AI applications in this industry can be as simple as improving user experiences when making appointments or speaking to chatbots about their health questions, or as complex as reading imaging scans, suggesting diagnoses, or even assisting in surgeries. Researchers at PwC have identified eight primary initiatives where AI can improve health and medicine: (1) helping patients practice day-to-day wellness; (2) detecting diseases early; (3) faster and more accurate diagnoses; (4)

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77 PRICEWATERHOUSECOOPERS, SIZE OF THE PRIZE: WHAT'S THE REAL VALUE OF AI FOR YOUR BUSINESS AND HOW CAN YOU CAPITALISE? 9 (2017), https://preview.thenewsmarket.com/Previews/PWC/DocumentAssets/476830.pdf (estimating a GDP increase of 26.1% in China, 14.5% in North America, 9.9% in Northern Europe, 11.5% in Southern Europe, 10.4% in developed Asia, 5.6% in Africa, Oceania, and other Asian markets, and 5.4% in Latin America).

78 *See id.*; *see generally* CAMPBELL, *supra* note 74.

79 Technological innovations have been changing the economic and social landscape for the past three hundred years, from the First Industrial Revolution (water and steam power), to the Second Industrial Revolution (electric power and the assembly line), to the Third Industrial Revolution (also called the "Digital Revolution," comprising of computers and the Internet). *See* MICROSOFT, THE FUTURE COMPUTED: ARTIFICIAL INTELLIGENCE AND ITS ROLE IN SOCIETY 93 (2018), https://news.microsoft.com/uploads/2018/01/The-Future-Computed.pdf. AI is the latest technological innovation and has been coined by some as the Fourth Industrial Revolution. As explained by Klaus Schwab, Founder and Executive Chairman of the World Economic Forum: "There are three reasons why today's transformations represent not merely a prolongation of the Third Industrial Revolution but rather the arrival of a Fourth and distinct one: velocity, scope, and systems impact. The speed of current breakthroughs has no historical precedent. When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance." Klaus Schwab, *The Fourth Industrial Revolution: What It Means, How to Respond*, WORLD ECON. F. (Jan. 14, 2016), https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.

80 MICROSOFT, *supra* note 79, at 8, 11.

augmenting decision-making by doctors; (5) helping clinicians provide more comprehensive treatment; (6) improving end of life care; (7) facilitating research; and (8) aiding healthcare training.[81] Researchers also estimate that AI will dramatically reduce costs in the healthcare industry, with some estimating AI will save up to $269.4 billion annually.[82] From detecting skin cancer with a smartphone,[83] to apps that can already answer an array of medical questions as well as physicians eighty percent of the time,[84] AI continues to make important strides in the healthcare context. The improvements in health and medicine will be significant, and, though likely adopted incrementally and haphazardly at least initially, there seems little doubt that AI will dramatically change the healthcare landscape.

2. Transportation

Both public and private transportation stand to be revolutionized by AI technology. Modern vehicles already commonly contain AI-assistive features, including brake assist, park assist, and lane-change assist.[85] In fact, the spectrum of autonomous vehicles extends from no automation, through partial and conditional, to full automation.[86] Cameras and sensors on vehicles are also often used to augment human drivers, though many manufacturers aim to develop fully autonomous vehicles. Companies such as Ford, General Motors, Tesla, Uber, and Waymo are investing in AI to develop driverless vehicles, with Waymo announcing that its cars have driven over ten million autonomous miles on public roads.[87] Autonomous vehicles' promises are numerous: improving traffic in cities, lowering commutes, improving the efficiency of public transportation systems, and perhaps most importantly, improving driver safety by reducing the number of accidents.[88] Yet regulating such vehicles and their manufacturers remains a thorny challenge, as we discuss below.

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81 *What Doctor? Why AI and Robotics Will Define New Health*, PwC (June 2017), https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/ai-robotics-new-health.pdf.

82 *AI and Healthcare: A Giant Opportunity*, FORBES INSIGHTS (Feb. 11, 2019), https://www.forbes.com/sites/insights-intelai/2019/02/11/ai-and-healthcare-a-giant-opportunity/.

83 *See, e.g.*, Amanda Capritto, *4 Ways to Check for Skin Cancer with Your Smartphone*, CNET (Jan. 1, 2020, 5:30 AM), https://www.cnet.com/news/how-to-use-your-smartphone-to-detect-skin-cancer/.

84 *See* Christopher McFadden, *These 7 AI-Powered Doctor Phone Apps Could Be the Future of Healthcare*, INTERESTING ENG'G (Jan. 24, 2019), https://interestingengineering.com/these-7-ai-powered-doctor-phone-apps-could-be-the-future-of-healthcare.

85 STANFORD UNIV., *supra* note 27, at 18–19.

86 *See* Davies, *supra* note 2.

87 *Id.*

88 *See* STANFORD UNIV., *supra* note 27, at 18–24.

3. Cybersecurity

As the cyber-threat landscape continues to increase for individuals, businesses, and governments, enhancing cybersecurity is becoming increasingly critical to protecting sensitive data and critical systems. AI applications have the potential to "help cope with the sheer complexity of cyberspace."[89] Individuals can use AI applications like email filtering and credit monitoring to manage their online life and protect their identity.[90] AI can also help users decipher and manage their privacy and security policies online.[91] Researchers are also developing AI applications to help combat the increasing threat of deep fakes.[92] In addition to augmenting human online interactions, AI can aid in cybersecurity's more technical aspects, such as helping organizations detect and react to cyber threats with a more effective response time. A recent survey of businesses demonstrated AI's importance in breach detection: 60 percent of respondents said that they would be unable to detect breaches without the aid of AI.[93] Yet such reliance on AI also increases vulnerability to hackers, who can exploit ML systems through the emerging field of "Adversarial AI."[94] Relatedly, AI is also fueling a renewed arms race among the cyber powers that has the potential not only to buttress defense-in-depth but also contribute to cyber insecurity as discussed next.[95]

D. Challenges Presented by AI

While AI offers numerous remarkable improvements to daily life, several experts have expressed concern for the "potential threat [AI] could pose to humankind."[96] These challenges include economic, legal, social, and cultural concerns, though there are also practical issues such

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89 *Preparing for the Future of Artificial Intelligence*, *supra* note 28, at 36.

90 Bernard Marr, *The 10 Best Examples of How AI Is Already Used in Our Everyday Life*, FORBES (Dec. 16, 2019, 12:13 AM), https://www.forbes.com/sites/bernardmarr/2019/12/16/the-10-best-examples-of-how-ai-is-already-used-in-our-everyday-life/.

91 Andy Greenberg, *An AI that Reads Privacy Policies So That You Don't Have To*, WIRED (Feb. 9, 2018, 7:00 AM), https://www.wired.com/story/polisis-ai-reads-privacy-policies-so-you-dont-have-to/.

92 Bernhard Warner, *Fighting Deepfakes Gets Real*, FORTUNE (July 24, 2019), https://fortune.com/2019/07/24/fighting-deepfakes-gets-real/ (explaining how companies are trying to develop tools to help users know when they are interacting with a modified photo or video).

93 Louis Columbus, "Why AI Is the Future of Cybersecurity," FORBES (July 14, 2019), https://www.forbes.com/sites/louiscolumbus/2019/07/14/why-ai-is-the-future-of-cybersecurity/.

94 *The New Cyberattack Surface: Artificial Intelligence*, ACCENTURE (Apr. 1, 2019), https://www.accenture.com/us-en/insights/artificial-intelligence/adversarial-ai.

95 *See, e.g.*, Matt Bartlett, *The AI Arms Race in 2019*, TOWARDS DATA SCI. (Jan. 28, 2019), https://towardsdatascience.com/the-ai-arms-race-in-2019-fdca07a086a7.

96 INST. ELEC. & ELECS. ENG'RS, ARTIFICIAL INTELLIGENCE: CALLING ON POLICY MAKERS TO TAKE A LEADING ROLE IN SETTING A LONG-TERM AI STRATEGY 3 (Oct. 15, 2017), http://globalpolicy.ieee.org/wp-content/uploads/2017/10/IEEE17021.pdf (position statement by the IEEE's European Public Policy Initiative).

as managing safety engineering, setting parameters on what an algorithm can teach itself, and how to ensure security. Safety, as it relates to AI and related technologies, "ought not to be confined to physical safety but should extend to concern for nonphysical harm, such as privacy, security, and the dehumanization of care for people at their most vulnerable."[97] Finding ways to navigate both the physical and nonphysical challenges presented by AI will be essential to building trust and fostering AI development. Additional elements that deserve further attention are related cybersecurity concerns, which manifest themselves quite differently from cyber-attacks (fed, for example, by bugs in code) with AI attacks taking the form of pattern "manipulation and poisoning" along with "inherent limitations in the underlying AI algorithms that currently cannot be fixed."[98] Although the AI challenges are numerous, this section focuses on three: economic, social and cultural, as well as legal and ethical issues in AI governance.

1. Economic Challenges

As detailed in the previous section, AI is expected to positively impact global GDP and generate productivity growth.[99] However, as the demand for automation increases, more workers are at risk of displacement.[100] A study from the McKinsey Global Institute found that nearly 50 percent of current work activities are subject to automation, which could displace as much as 15 percent of the global workforce,[101] contrib-

97 Michael Guihot, Anne F. Matthew & Nicolas P. Suzor, *Nudging Robots: Innovative Solutions to Regulate Artificial Intelligence*, 20 VAND. J. ENT. & TECH. L. 385, 407 (2017).

98 MARCUS COMITER, *Attacking Artificial Intelligence: AI's Security Vulnerability and What Policymakers Can Do About It,* BELFER CTR SCI & INT'L AFF. 80 (Aug. 2019), https://www.belfercenter.org/sites/default/files/2019-08/AttackingAI/AttackingAI.pdf.

99 *AI to Drive GDP Gains of $15.7 Trillion with Productivity, Personalisation Improvements*, PRICEWATERHOUSECOOPERS (June 27, 2017), https://www.pwc.com/gx/en/news-room/press-releases/2017/ai-to-drive-gdp-gains-of-15_7-trillion-with-productivity-personalisation-improvements.html.

100 *See, e.g.*, Olivia Solon, *Self-Driving Trucks: What's the Future for America's 3.5 Million Truckers?*, GUARDIAN (June 17, 2016, 7:00 AM), https://www.theguardian.com/technology/2016/jun/17/self-driving-trucks-impact-on-drivers-jobs-us (explaining the potential displacement of truck drivers as automated vehicles replace the profession). Other occupations with a high risk of task automation include packaging and filling machine operators, food preparation workers, payroll clerks, computer network support specialists, medical assistants, retail salespersons, computer programmers, registered nurses, housekeeping cleaners, home-health aides, software developers, and management analysts; Mark Muro, Robert Maxim & Jacob Whiton, *Automation and Artificial Intelligence: How Machines Are Affecting People and Places*, BROOKINGS INST. (Jan. 2019), https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf.

101 James Manyika & Kevin Sneader, *AI, Automation, and the Future of Work: Ten Things to Solve For*, MCKINSEY GLOBAL INST. 2–3 (June 2018), https://www.mckinsey.com/featured-insights/future-of-work/ai-automation-and-the-future-of-work-ten-things-to-solve-for.

uting to longstanding concerns about a tragedy of the AI commons.[102] Such alarming statistics may be partially offset by the fact that AI will also create new jobs, with some estimates projecting that it could contribute as many or even more jobs than it disrupts (though transitions would be far from seamless with extensive retraining required to support displaced workers pursuing these new occupations).[103] Though the precise impact of AI on labor markets is unknown, the EU Commission report on *The Future of Work? Work of the Future!* emphasized one central important point: "Automation outcomes are not pre-determined but are shaped by the policies and choices we make."[104] While AI will have a profound impact on the skills needed in the workforce, the direct economic impact of AI will depend on governance decisions made today.[105]

2. Social and Cultural Challenges

Beyond these concerns over how AI will affect the workforce landscape, researchers are increasingly concerned with how to navigate the social and cultural aspects of living and working alongside AI. As indicated by the title of a recent *Washington Post* article—"As Walmart turns to robots, it's the human workers who feel like machines"—it is important to remember the human aspect of AI deployment.[106] When Walmart introduced robots to automate janitorial and stock-shelfing tasks, it was met with concerns from human co-workers feeling devalued at work, while customers were unsurprisingly also thrown off by the six-foot tall robot meandering throughout the store.[107] Despite efforts to cre-

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102 *See* Roy M. Turner, *The Tragedy of the Commons and Distributed AI Systems*, PROC. 12TH INT'L WORKSHOP ON DISTRIBUTED AI 370, 371 (1993).

103 John Hawksworth, *AI and Robots Could Create as Many Jobs as They Displace*, WORLD ECON. F. (Sept. 18, 2018), https://www.weforum.org/agenda/2018/09/ai-and-robots-could-create-as-many-jobs-as-they-displace/ (highlighting the importance of businesses and governments in fostering "increased investment in retraining workers for new careers, boosting their digital skills but also reframing the education system to focus on human skills that are less easy to automate: creativity, co-operation, personal communication, and managerial and entrepreneurial skills.").

104 Michel Servoz, *The Future of Work? Work of the Future! On How Artificial Intelligence, Robotics and Automation Are Transforming Jobs and the Economy in Europe*, EU COMM'N 3 (2019), https://ec.europa.eu/digital-single-market/en/news/future-work-work-future.

105 As stated by Bank of America's Chief Technology Officer Cathy Bessant, "The effect of AI on jobs is totally, absolutely within our control . . . This isn't what we let AI do to the workforce, it's how we control its use to the good of the workforce." *AI and the Future of Work*, WIRED (Apr. 2018), https://www.wired.com/wiredinsider/2018/04/ai-future-work/.

106 Drew Harwell, *As Walmart Turns to Robots, It's the Human Workers Who Feel Like Machines*, WASH. POST (June 6, 2019, 8:00 AM), https://www.washingtonpost.com/technology/2019/06/06/walmart-turns-robots-its-human-workers-who-feel-like-machines/.

107 *Id.* ("This awkward interplay of man vs. machine could become one of the defining tensions of the modern workplace as more stores, hotels, restaurants and other businesses roll in robots that could boost company reliability and trim labor costs.").

ate "human-friendly" robots, there is currently no "agreed-upon etiquette for how robots and people should communicate."[108]

The Walmart dilemma is only one example of the variety of social and cultural challenges arising from the development of AI. "We may thrill to the idea of AI systems helping us to filter information to suit personalized wants and needs, but belatedly discover the same technologies can produce fake news, closed echo chambers of public opinion, and the erosion of a shared public reality."[109] This creates concerns for the very foundation of democracy as deep fakes become more prevalent and difficult to detect.[110] It also creates important questions for human autonomy and market manipulation such as the extent to which we are comfortable with robots nudging what we buy, who we date, who we vote for, and what we watch.[111] Some of these concerns are not specific to AI, but each of them raises important questions as the field continues to develop.

3. Legal & Ethical Challenges

One approach to mitigating or managing the concerns mentioned above is through the legal system, yet the judiciary is managing its own tensions with applications of AI.[112] AI is exacerbating many of the same challenges that new technologies bring to existing bodies of law, including competition law, information security, and privacy law, while also creating new depth in issues such as negligence or products liability.[113]

Privacy law may be the most apt example of this challenge. As countries around the world are developing new privacy laws, there are numerous reports detailing the tensions between some of the fundamental data protection principles and the capabilities of AI.[114] Data protection regulation attempts to minimize bias, discrimination, and unfairness regardless of specific technologies involved.[115] Regulators have heightened concerns with AI because of what is referred to as the "black box"

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108 *Id.*

109 Bollier, *supra* note 29, at 5.

110 *See* Chesney & Citron, *supra* note 10, at 1754, 1757.

111 *Id.* at 1769, 1806, 1808.

112 *See, e.g.*, Anjanette H. Raymond & Scott J. Shackelford, *Jury Glasses: Wearable Technology and Its Role in Crowdsourcing Justice*, 17 CARDOZO J. CONFLICT RES. 115, 116 (2015).

113 *See, e.g.*, Michael Froomkin, Ian Kerr & Joelle Pineau, *When AIs Outperform Doctors: Confronting the Challenges of a Tort-Induced Over-Reliance on Machine Learning*, 61 Ariz. L. Rev. 33, 51, 58, 66, 94 (2019) (highlighting the arguments for negligence in the event that AI's offer care that is proven to be more accurate and effective than a human doctor).

114 *See, e.g.*, Cate & Dockery, *supra* note 65, at 115–20 (highlighting the tensions between fair information practice principles such as data minimization, purpose and use limitations, transparency, etc. and artificial intelligence).

115 *Id.* at 119.

phenomenon, where algorithms can sometimes create surprising or unanticipated correlations and conclusions based on the inputs AI receives.[116] This has resulted in efforts to foster transparency and explainability of AI: "As [AI technologies] become a central force in society, the field is shifting from simply building systems that are intelligent to building intelligent systems that are human-aware and trustworthy."[117] However, there is little agreement on how to best accomplish and enforce this goal.

Trustworthiness and human awareness also require addressing ethical concerns with AI, such as training AI to react in certain situations or deciding in which circumstances to allow decision-making by AI.[118] For example, how does an engineer decide whether to program an autonomous vehicle to protect the driver of a car rather than an animal or a pedestrian? Who should be making the moral and ethical decisions required to train an AI, and how do we foster rules to help govern those decisions?

4. Summary

While this section does not provide a comprehensive survey of all the challenges facing a world increasingly powered by AI, it does emphasize that the future of how we interact with and respond to AI depends on governance decisions made in the near future. Any approach to regulating, moderating, or generally governing AI must consider the benefits and challenges of AI as well as the opportunities for novel governance structures given the wide range of technologies, industries, and sectors in play.[119] The following section will explore some of the current attempts to regulate, monitor, and foster advancements in AI before examining the role that polycentric government could play in this effort.

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116 *Id.*

117 STANFORD UNIV., *supra* note 27, at 14. Transparency and explainability are an increasing focus with AI governance, as these are essential elements for building trust in AI systems. *See, e.g., HLEG AI Ethics Guidelines*, *supra* note 67, at 18. As explainability is described by Singapore's Model AI Governance Framework, "[a]n algorithm deployed in an AI solution is said to be explainable if how it functions and arrives at a particular prediction can be explained." *Infra* note 182, at 13.

118 A survey of 2.3 million people from around the world found that preferences for the ethics of autonomous vehicles are not universal, but the increasing use of automation will force moral and ethical calculations to be concrete, explainable, and carefully crafted. Edmond Awad et al., *The Moral Machine Experiment*, 563 NATURE 59, 59, 62, 65 (2018), https://www.nature.com/articles/s41586-018-0637-6. As an article in the *New Yorker* states, "In a future dominated by driverless cars, moral texture will erode away in favor of a rigid ethical framework." Caroline Lester, *A Study on Driverless-Car Ethics Offers a Troubling Look into Our Values*, NEW YORKER (Jan. 24, 2019), https://www.newyorker.com/science/elements/a-study-on-driverless-car-ethics-offers-a-troubling-look-into-our-values.

119 STANFORD UNIV., *supra* note 27, at 6, 36, 38, 41, 44.

II. U.S. APPROACH TO REGULATING AI

Because of the substantial conveniences, economic opportunities, and national security challenges related to AI, the need for AI governance is manifest. Some experts caution that regulation will stifle innovation and should be approached carefully or not at all while others argue that the potential malicious uses of general AI should stop its development entirely.[120] Rather than taking a wait-and-see approach to the impact of these new technologies, the best way to prevent future malicious uses is to grapple with governance concerns now, though not necessarily through the use of black-letter law in all instances, as discussed further below. AI applications are used across a wide span of sectors, by a variety of public and private actors, and in a myriad of technologies.[121] The broad landscape of AI presents challenges for regulators around the world, and although numerous efforts–some of which are outlined below–are aimed at mitigating these challenges, the expansive nature of the issue leaves ample room for improvement.[122]

A. Applicable U.S. Federal Law

The federal government has not passed comprehensive legislation on AI (nor would such an approach be advisable given the myriad issues in play that are similar to debates surrounding cybersecurity and Internet of Things regulation),[123] but the U.S. government has generally recognized the potential benefits of AI and has devoted resources to ensuring U.S. leadership in its development. In February 2019, for example, President Trump issued Executive Order 13859, *Maintaining American Leadership in Artificial Intelligence*, stating that U.S. leadership would require "a concerted effort to promote advancements in technology and innovation, while protecting American technology, economic and national security, civil liberties, privacy, and American values and enhancing international and industry collaboration with foreign partners and allies."[124] Though regulating AI has not been a priority, the President, Congress, executive agencies, the states, and the courts have all spent

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120 Elon Musk warns that AI "'is a fundamental risk to the existence of human civilization' and poses 'vastly more risk' than North Korea." *Artificial Intelligence: With Great Power Comes Great Responsibility: Joint Hearing Before the Subcomm. on Research and Technology and Subcomm. on Energy*, 115th Cong. 4 (2008).

121 *Id.* at 8, 23.

122 CLIFFORD CHANCE, *The challenges of regulating artificial intelligence: Robots and regulation*, TALKING TECH (Apr. 27, 2017), https://talkingtech.cliffordchance.com/en/emerging-technologies/artificial-intelligence/ai-and-the-law.html.

123 *See, e.g.*, Scott J. Shackelford, *Governing the Internet of Everything*, 37 CARDOZO ARTS & ENT. L.J. 701, 702–03 (2019).

124 Exec. Order No. 13,859, 84 Fed. Reg. 3,967 (Feb. 11, 2019).

considerable resources exploring strategic priorities and challenges around its development.[125]

The first *National AI R&D Strategic Plan* was released in 2016 and updated in June 2019, highlighting the priority of research and development of emerging technologies such as AI. While this strategy specifically does not "describe or recommend policy or regulatory actions related to the governance or deployment of AI,"[126] it attempts to identify research priorities "that industry is unlikely to address on their own."[127] A similar approach to identifying gaps between industry priorities and AI governance will be necessary in the future, as discussed in Part V. Congressional committees have also been exploring the challenges and benefits of AI; for example, a hearing in June 2018 titled *Artificial Intelligence – With Great Power Comes Great Responsibility* brought together experts to identify the potential of AI as well as the governance structures needed to help it flourish.[128]

Congress has already considered several pieces of legislation regarding AI. In the 116th Congress, the term "artificial intelligence" is in 133 different pieces of legislation, while the 115th Congress introduced fifty bills with the phrase.[129] Many of these are either sector-specific or are creating committees for exploratory research. For example, the National Defense Authorization Act for Fiscal Year 2019 directs the Department of Defense regarding AI activities;[130] the FAST Act includes language about developing an assessment of the impact of autonomous

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125 *Id.*

126 NAT'L SCI. & TECH. COUNCIL, THE NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT STRATEGIC, PLAN, UPDATE 2 (2019).

127 *Id.* at 5.

128 *Artificial Intelligence: With Great Power Comes Great Responsibility: Hearing Before the H. Subcomm. on Research and Tech. & the H. Subcomm. on Energy, H. Comm. on Sci., Space, and Tech.*, 115th Cong. (2018).

129 This data is the result of searching on Congress.gov for "artificial intelligence" and narrowing by bill text only. Search completed September 5, 2020.

130 The NDAA defines AI as "(1) Any artificial system that performs tasks under varying and unpredictable circumstance without significant human oversight, or that can learn from experience and improve performance when exposed to data sets. (2) An artificial system developed in computer software, physical hardware, or other context that solves tasks requiring human-like perception, cognition, planning, learning, communication, or physical action. (3) An artificial system designed to think or act like a human, Including cognitive architectures and neural networks. (4) A set of techniques, including machine learning, that is designed to approximate a cognitive task. (5) An artificial system designed to act rationally, including an intelligent software agent or embodied robot that achieves goals using perception, planning, reasoning, learning, communicating, decision making, and acting." John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. 115-232, § 238, 132 Stat. 1658 (2018), https://www.congress.gov/115/bills/hr5515/BILLS-115hr5515enr.pdf. *See also* Jack Corrigan, *AI, Cyber Get Big Boost in Senate-Passed NDAA*, NEXTGOV (June 28, 2019), https://www.nextgov.com/policy/2019/06/ai-cyber-get-big-boost-senate-passed-ndaa/158100/ ("The legislation would free up some $600 million for AI and cyber research, lock down the federal supply chain and prep the Pentagon for the cloud.").

vehicles on transportation systems;[131] the proposed AI in Government Act examines ways to facilitate AI adoption in government agencies;[132] and the proposed AI Jobs Act explores the impact of AI on the future of work and how to "retrain American workers for our 21st century economy."[133] These are only a few examples of the many legislative efforts around AI—and it should be noted that numerous other laws, including in the cybersecurity context, touch more obliquely on AI[134]—but there promises to be more to come in the near future. Still, what is missing is an integrated, "'true framework'" for a national AI strategy,"[135] which remains lacking despite the rollout of the American AI Initiative in November 2019,[136] though the core elements of what such a framework could entail are discussed in Part VI.

B. Applicable U.S. State Law

Similar to the federal government, U.S. states have not passed substantial comprehensive legislation around artificial intelligence, but they are aware of its potential impact on citizens and in some cases have set up mechanisms to limit negative impacts. The most common state laws on AI are either exploratory committees and task forces, sectoral regulations, of specific instance regulations.[137] Vermont's AI Task Force, New York's Algorithm Monitoring Task Force, and the District of Columbia's Future of Work Task Force were all created by state legislation for the purpose of examining AI or a specific impact of AI.[138] States are often stepping in where the market is unlikely to fill a consumer or societal

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131 Fixing America's Surface Transportation Act, Act, Pub. L. No. 114-94, 129 Stat. 1586 (2015), at § 6025 (ordering an assessment of "the status of autonomous transportation technology policy developed by public entities in the United States" and the "organizational readiness of the Department to address autonomous vehicle technology challenges, including consumer privacy protections.").

132 AI in Government Act of 2019, H.R. 2575, 116th Cong. (2019).

133 AI JOBS Act of 2019, H.R. 827, 116th Cong. (2010-20), § 2. For an up-to-date list of current legislative efforts for AI, see the Center for Data Innovation's AI Legislation Tracker at https://www.datainnovation.org/ai-policy-leadership/ai-legislation-tracker/ (last visited Sept. 27, 2019).

134 *See* Micha Nandaraj Gallo, *Senate Reintroduces IoT Cybersecurity Improvement Act*, INSIDE PRIVACY (Mar. 12, 2019), https://www.insideprivacy.com/internet-of-things/senate-reintroduces-iot-cybersecurity-improvement-act/.

135 Martijn Rasser, *The United States Needs a Strategy for Artificial Intelligence*, FOREIGN POL'Y (Dec. 24, 2019), https://foreignpolicy.com/2019/12/24/national-artificial-intelligence-strategy-united-states-fall-behind-china/.

136 This initiative was created by executive order and does not include new funding, but rather "orders the federal government to direct existing funds, programs, and data in support of AI research and commercialization." Tom Simonite, *Trump's Plan to Keep America First in AI*, WIRED (Feb. 11, 2019), https://www.wired.com/story/trumps-plan-keep-america-first-ai/.

137 *AI Policy – United States*, FUTURE LIFE INST., https://futureoflife.org/ai-policy-united-states/?cn-reloaded=1&cn-reloaded=1&cn-reloaded=1 (last visited Oct. 30, 2019).

138 *Id.*

need.[139] This has resulted in a checkerboard of laws across the United States, but this has its benefits with states acting as laboratories of AI governance similar to the role being played by the EU globally as is explored below.[140]

One common area of states' AI focus is consumer privacy. California's proposed bot disclosure law, for example, would mandate that individuals know that they are interacting with a machine whenever it is influencing a commercial transaction or informing a vote in an election,[141] while a recent Illinois law will regulate use of AI to evaluate employment interviews.[142] California's new privacy legislation—the California Consumer Privacy Act (CCPA)—will also have an impact on AI development, as it affords individuals greater transparency and control over the use of their personal data.[143]

The other common sector-specific regulations around AI are related to automated vehicles as is explored in Part IV, with forty-five states and the District of Columbia all having laws in place around autonomous vehicles.[144] Other states have issued executive orders on the topic.[145] Some of these efforts are merely exploring the potential impact of automated vehicles on roadways and on transportation networks, while others are exploring specific regulations to guide the ethical development of these driverless cars.[146]

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139 *Id.*

140 ARTIFICIAL INTELLIGENCE FOR EUROPE, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. 2 (2018), https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-237-F1-EN-MAIN-PART-1.PDF.

141 B.O.T. (Bolstering Online Transparency) Act, SB 1001, Cal. Bus. & Prof. Code §§ 17940-17943 (2019).

142 Artificial Intelligence Video Interview Act, HB 2557, 820 Ill. Comp. Stat. Ann. 42 (2019).

143 California is pioneering legislation in AI, with numerous bills introduced related to this topic: "AB-1281, a bill requiring businesses to publicly disclose use of facial recognition technology; SB-730, a bill to establish a commission on the future of work; SB-348, a bill to encourage the Governor to appoint an AI special advisor and develop a statewide AI strategic plan; AB-594, the California AI Act of 2020, which would develop a policy framework to manage the use of AI; and AB-976, a bill that would establish an AI in State Government Services Commission to gather input on how to use AI to improve state services." Brandie Nonnecke, *Fair, Reliable, and Safe: California Can Lead the Way on AI Policy to Ensure Benefits for All*, BERKELEY BLOG (May 28, 2019), https://blogs.berkeley.edu/2019/05/28/fair-reliable-and-safe-california-can-lead-the-way-on-ai-policy-to-ensure-benefits-for-all/.

144 *See Autonomous Vehicles State Bill Tracking Database*, Nat'l Conf. St. Legislators, http://www.ncsl.org/research/transportation/autonomous-vehicles-legislative-database.aspx (last visited Sept. 6, 2020).

145 *Autonomous Vehicles: Self-Driving Vehicles Enacted Legislation*, NAT'L CONF. ST. LEGISLATURES (Feb. 18, 2020), https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.

146 *Id.*

C. Applicable U.S. Case Law

The overwhelming discussion about AI and the US judicial system relates to the benefits and concerns of using AI as an advocate or a judge[147] while the case law itself is rather undeveloped. Though a few cases have emerged regarding AI, many of them were dismissed for lack of jurisdiction or lack of basis for a claim.[148] In one case where the plaintiff appealed his right to access the source code for AI, the appellate court denied his right to review the code.[149]

One possible explanation for the lack of judicial precedent in this area may be that it is too new. While AI is often used for decision-making, the decisions currently made by AI are often less critical or are unlikely to cause substantial harm.[150] Another possible explanation may be that the judicial system is waiting for more legislative guidance on AI—relegating its decision-making to areas where there is already some precedent.[151] Balancing the economic and societal potential of AI with the prospective harms and challenges is a difficult task and one that is potentially better left to legislators.

While the judicial system may be slow to issue groundbreaking case law in AI, either due to the lack of regulations or a fear of stifling innovation, it would be unsurprising to see an uptick in case law for AI in the next few years. As the importance of AI decisions continues to increase

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147 Artificial intelligence is seen as having great potential to help the legal system become more efficient—helping judges manage caseloads more seamlessly, assisting lawyers with research and writing more efficiently, and granting greater access to the judiciary and greater knowledge of the law to the public as a whole. *See generally* Larry N. Zimmerman, *Artificial Intelligence in the Judiciary*, 85 J. KAN. B. ASS'N 19 (2016); William J. Connell, *Artificial Intelligence in the Legal Profession—What You Might Want to Know*, 35 COMPUT. & INTERNET L. 32, 32–33 (2018).

148 *See, e.g.*, Hendricks v. United States, 140 Fed. Cl. 496, 499 (Fed. Cl., 2018) (dismissing complaint that alleged an artificial intelligence computer system "stole [her] thoughts"); Caruso v. United States, No. 2:16-cv-2902-TLN-KJN PS, 2017 U.S. Dist. LEXIS 61290, at *1–2 (E.D. Cal. Apr. 21, 2017) (dismissing complaint that artificial intelligence was used along with electronic monitoring, biological trade secrets, and social engineering to exact physical and psychological torture on him the plaintiff); Davis v. U.S. Presidential Task Force, No. 1:18-cv-01267-TWP-TAB, 2018 U.S. Dist. LEXIS 76474 at *1 (S.D. Ind. May 7, 2018) (dismissing complaint that alleged that plaintiff had "an illegal Artificial Intelligence" implanted in his body that was used to illegally charge him with crimes and to psychologically torture him).

149 People v. Johnson, 2019 Cal. App. Unpub. LEXIS 4629, at *6–10 (Cal. Ct. App. July 11, 2019) (though this ruling was ordered not published and will not have precedential affect).

150 Eric Colson, *What AI-Driven Decision Making Looks Like*, HARV. BUS. REV. (July 08, 2019), https://hbr.org/2019/07/what-ai-driven-decision-making-looks-like.

151 *Artificial Intelligence Litigation: Can the Law Keep Pace with The Rise of the Machines?*, Quinn Emanuel Trial Lawyers, https://www.quinnemanuel.com/the-firm/publications/article-december-2016-artificial-intelligence-litigation-can-the-law-keep-pace-with-the-rise-of-the-machines/ ("Protection for the public from AI technologies will need to be enacted, and should be, but our courts may be the first to address these novel legal issues. . . . Unlike legislation, however, the protection provided by the courts is remedial not preventative.").

and those decisions have increasing consequences, courts may be the nimblest avenue for individuals to seek redress.[152] Courts have historically been well-placed to respond to constitutional issues around technology, and if AI continues to proliferate without legislation in place to guide it, the judicial system may play an increasing role in this field.[153]

As is apparent, the United States has, to date, taken a largely hands-off approach to regulating new AI technologies and applications. In contrast, as we will see, the EU has taken a much more hands-on regulatory approach, which—even though it is not an AI superpower in the same league as the United States or China[154]—is having an impact on AI governance globally as explored in Part III.

III. COMPARATIVE APPROACHES TO AI GOVERNANCE

This Part broadens the discussion of AI governance to move away from a U.S.-centric, black letter law focus to better understand the multiple "regulatory modalities" in place including norms, markets, code,[155] self-regulation, and multilateral collaboration, all of which contribute to AI governance. In particular, we consider the role of the private sector, along with ethical guidelines and how other AI powers are approaching similar questions (namely the EU and China), as well as applicable international law. The case study of autonomous vehicle (AV) regulation helps narrow the scope of our investigation and guide the discussion given that this is among the most mature areas of AI governance to date.

A. Private Initiatives & Ethical Frameworks

Although the regulatory landscape is still in early stages of development, numerous private initiatives are attempting to foster responsible AI development and deployment. These initiatives involve the private sector, academia, civil society, and partnerships between these various components.[156] It has become common practice for tech companies to develop AI principles with Google, Microsoft, Intel, and IBM all having published AI principles or guidelines.[157] Some of the premier universi-

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152 *Id.*

153 Aleš Završnik, *Criminal Justice, Artificial Intelligence Systems, and Human Rights*, ERA FORUM (Feb. 20, 2020) https://doi.org/10.1007/s12027-020-00602-0.

154 *See, e.g.*, Scott J. Shackelford, Scott Russell, & Jeffrey Haut, *Bottoms Up: A Comparison of "Voluntary" Cybersecurity Frameworks*, 16 UNIV. CAL. DAVIS BUS. L.J. 217 (2016).

155 *See* LAWRENCE LESSIG, CODE: VERSION 2.0 125 (2006).

156 *See e.g.*, *AI and Shared Prosperity Initiative*, PARTNERSHIP ON AI (last visited Sept. 19, 2020), https://www.partnershiponai.org/shared-prosperity-initiative/.

157 Sundar Pinchai, *AI at Google: Our Principles*, GOOGLE (June 7, 2018), https://www.blog.google/topics/ai/ai-principles/; *Responsible AI*, MICROSOFT, https://www.microsoft.com/en-us/ai/responsible-ai?activetab=pivot1:primaryr6; *Artificial Intelligence: The Public Policy Opportunity*, INTEL (2017), https://blogs.intel.com/policy/files/2017/10/Intel-Artificial-Intelligence-Public-Policy-White-Paper-2017.pdf; *Everyday Ethics for Artificial*

ties around the world have developed ethical guidelines around AI development and deployment.[158] The chart below details some of the most prevalent private and academic initiatives to develop responsible or ethical principles around AI development. While this list is not exhaustive, it illuminates how extensively organizations, academic institutions, and civil society are considering the ethical and societal impacts of AI.

TABLE 1: PRIVATE INITIATIVES FOR AI GOVERNANCE

Private Sector Initiatives	
Accenture	Ethical Framework for Responsible AI and Robotics
Google	Google's AI Principles
IBM	Everyday Ethics for Artificial Intelligence; Principles for Trust and Transparency
Intel	AI Public Policy Principles
Microsoft	Microsoft AI Principles
Academic Initiatives	
Harvard University	Ethics and Governance of Artificial Intelligence
Peking University, Tsinghua University	Beijing AI Principles (published in collaboration with the Chinese Academy of Sciences and other stakeholders)
Stanford University	100 Year Study on AI
University of Montreal	Montreal Declaration for A Responsible Development of AI
University of Oxford	Government AI Readiness Index
Nonprofit & Collaborative Initiatives	
ACM	Statement on Algorithmic Transparency and Accountability
FATML	Principles for Accountable Algorithms and a Social Impact Statement for Algorithms
Future of Life Institute	Asilomar AI Principles
IEEE	Ethically Aligned Design; Ethical Aspects of Autonomous and Intelligent Systems
OpenAI	OpenAI Charter
Partnership on AI	Tenets of the PAI to Benefit People and Society
Public Voice Coalition	12 Universal Guidelines for the Development of AI

Intelligence, IBM DESIGN PROGRAM OFFICE, https://www.ibm.com/watson/assets/duo/pdf/everydayethics.pdf.

158 The Beijing AI Principles, published in May 2019, were developed by a collaboration between the Beijing Academy of Artificial Intelligence (BAAI), Peking University, Tsinghua University, the Chinese Academy of Sciences, and the Artificial Intelligence Industry Innovation Strategy Alliance (AITISA). *Beijing AI Principles*, BEIJING ACADEMIC OF ARTIFICIAL INTELLIGENCE (May 28, 2019), https://baip.baai.ac.cn/en.

The private initiatives for governing AI are focused on the concerns that AI poses for society, and many of the initiatives focus on prioritizing humans.[159] The chart below details Google's AI Principles,[160] the Beijing AI Principles (discussed further below),[161] and the IEEE Ethically Aligned Design Principles.[162] By comparing these three principles in the chart below, it becomes clear that developing AI to be beneficial to humans is of central importance.

TABLE 2: COMPARISON OF PRIVATE AI GOVERNANCE INITIATIVES

Google's AI Principles	**Beijing AI Principles**	**IEEE Ethically Aligned Design**
Be socially beneficial.	Do good.	Human rights
Avoid creating or reinforcing unfair bias.	For humanity	Well-being
Be built and tested for safety.	Be responsible	Data Agency
Be accountable to people.	Control risks	Effectiveness
Incorporate privacy design principles.	Be ethical	Transparency
Uphold high standards of scientific excellence.	Be diverse and inclusive	Accountability
Be made available for uses that accord with these principles.	Open and share.	Awareness of Misuse
		Competence

Another theme that runs across these and other AI principles is the critical role that ethics will play in AI governance. Numerous frames are applicable in this exploration of ethics, including both so-called fundamental and applied ethics to help promote a degree of "self-reflection" in the research and development of new AI applications.[163] Metaethics is one useful framework, which might be conducted near the object of in-

159 Pinchai, *supra* note 157; *AI at Google: Our Principles*, *supra* note 158; *Artificial Intelligence: The Public Policy Opportunity*, *supra* note 157; *Everyday Ethics for Artificial Intelligence*, *supra* note 158.

160 Pinchai, *supra* note 157.

161 *Beijing AI Principles*, *supra* note 158.

162 *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems*, INST. ELEC. & ELECS. ENG'RS (2019), https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/ead1e.pdf?utm_medium=undefined&utm_source=undefined&utm_campaign=undefined&utm_content=undefined&utm_term=undefined.

163 *See* Angela Daly et al., *Artificial Intelligence, Governance and Ethics: Global Perspectives*, 6 (2019), https://arxiv.org/pdf/1907.03848.pdf.

quiry necessitating a more narrow and pragmatic approach, or distant providing space and time for a broader inquiry.[164] To be effective, it has been argued that AI ethics requires two traits: "First, it should use weak normativity and should not universally determine what is right and what is wrong. Second, AI ethics should seek close proximity to its designated object."[165]

One application of these ideas to AI is in the field of autonomous vehicle governance, which is explored further below. In particular, the MIT Media Lab has taken on the idea of crowdsourcing ethics in the IoT context through its *Moral Machine* initiative.[166] The idea is to have participants vote on how an out-of-control autonomous vehicle should manage an array of ethically difficult scenarios, such as whether to sacrifice the driver and passengers to save a larger number of pedestrians.[167] The results—gathered from "nearly 40m decisions made by people from 233 countries"[168]—point to some general preferences (such as preferring to save a mother pushing a stroller over a cat) but also a wide array of cultural variation generally grouped into "Western," "Eastern," and "Southern" blocks.[169] For example, there was less of a preference to save younger people in "Eastern" nations, which points to an interesting problem in AI governance; as stated by the *Economist*, "Self-driving cars, it seems, may need the ability to download new moralities when they cross national borders."[170] Such an observation poses a particularly relevant and timely issue for economically integrated regions, including the EU.

B. European Union

Although perhaps not the AI superpower of the United States or China, the EU has effectively positioned itself as a *regulatory* AI epicenter, similar to its influential status in the data privacy and cybersecurity contexts.[171] Indeed, the EU's 2018 General Data Protection Regulation (GDPR) is of direct relevance to questions of AI governance. In short, GDPR is an expansive regulatory regime with a wide array of requirements on covered firms ranging from mandating consent for the processing of personal information to ensuring data portability, mandating that firms disclose a data breach within 72-hours of becoming aware of the

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164 *See id.* at 9.

165 *Id.*

166 *See Moral Machine*, MIT, http://moralmachine.mit.edu/ (last visited Oct. 7, 2019).

167 *Id.*

168 *Whom Should Self-driving Cars Protect in an Accident?*, ECONOMIST (Oct. 27, 2018), https://www.economist.com/science-and-technology/2018/10/27/whom-should-self-driving-cars-protect-in-an-accident.

169 *Id.*

170 *Id.*

171 *See, e.g.*, Shackelford, Russell, & Haut, *supra* note 154, at 217.

incident, and appointing Data Protection Officers.[172] Section 5 of GDPR in particular is of interest in the AI context given its focus on the right to object to the processing of personal information and prohibitions against profiling.[173] As of this writing, the European Commission has not yet clarified how these provisions should apply to algorithmic decision-making of the kind common in the AI context, but, given the potential fines for non-compliance and the increasingly global reach of GDPR with more than 100 nations having similar omnibus privacy laws and others considering them so as to comply with GDPR data transfer provisions, it will likely have a major impact on AI service providers around the world.[174]

Aside from GDPR, the EU's nonbinding Resolution on Civil Law Rules on Robotics called on the European Commission to release a proposal on "legal questions related to the development and use of robotics and AI" and to consider more broadly how the EU's legal frameworks "should be updated and complemented, where appropriate, by guiding ethical principles."[175] Other recent EU efforts have included the 2018 Communication on Artificial Intelligence for Europe, which had the stated aims of "boosting the EU's technological and industrial capacity, and AI uptake; of preparing for socio-economic changes brought about by AI (with a focus on labour, social security and education); and of ensuring 'an appropriate ethical and legal framework, based on the Union's values and in line with the Charter of Fundamental Rights of the EU.'"[176] Perhaps the most prominent recent initiative designed to build out an EU approach to AI governance was the European Commission's High-Level Expert Group (HLEG) on AI, which provided a useful summary of the current, complex set of EU legal sources that apply to AI:

> EU primary law (the Treaties of the European Union and its Charter of Fundamental Rights), EU secondary law (such as the General Data Protection Regulation, the

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172 *See, e.g.*, *Top Ten Operational Impacts of the EU's General Data Protection Regulation*, INT'L ASS'N PRIV. PROF. (2016), https://ess.csa.canon.com/rs/206-CLL-191/images/IAPP-Top-10-Operational-Impacts-of-GDPR.pdf?TC=m&CN=CSA_OMNIA_Partners&CS=CSA&CR=T1_Gov%20GenNonProfit (last visited June 5, 2018).

173 *See* Daly et al., *supra* note, 163, at 13.

174 *See, e.g.*, Michael Baxter, *How GDPR is Shaping Global Data Protection*, PRIVSEC REP. (Aug. 24, 2018), https://gdpr.report/news/2018/08/24/how-gdpr-is-shaping-global-data-protection/.

175 *European Parliament Resolution of 16 February 2017 with Recommendations to the Commission on Civil Law Rules on Robotics*, at 7 (Feb. 16, 2017), https://www.europarl.europa.eu/doceo/document/TA-8-2017-0051_EN.pdf.

176 ARTIFICIAL INTELLIGENCE FOR EUROPE, COMM. FROM THE COMM'N TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMM. AND THE COMM. OF THE REGIONS., COM (2018) 237 final at 3, https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-237-F1-EN-MAIN-PART-1.PDF.

> Product Liability Directive, the Regulation on the Free Flow of Non-Personal Data, anti-discrimination Directives, consumer law and Safety and Health at Work Directives), the UN Human Rights treaties and the Council of Europe conventions (such as the European Convention on Human Rights), and numerous EU Member State laws. Besides horizontally applicable rules, various domain-specific rules exist that apply to particular AI applications (such as for instance the Medical Device Regulation in the healthcare sector).[177]

In particular, the HLEG has issued Guidelines for Trustworthy AI in attempt to help organizations develop AI that is both ethical and technically robust. These seven principles are voluntary guidelines, but are useful to help organizations consider responsible practices around AI development and deployment.[178] Already, the HLEG has offered another deliverable in the form of its June 2019 Policy and Investment Recommendations for Trustworthy AI, complete with thirty-three recommendations for the sustainable use of AI so as to empower humanity.[179] Suggestions from this Policy include a ban on the use of AI for mass surveillance, either from private or public sector stakeholders, along with a bar on the "mass scoring" of individuals (a likely nod to China's social credit system).[180] Other efforts to explore and encourage responsible practices around AI in Europe are being carried forth by the Norwegian Data Protection Authority, France, Germany, Austria, and the UK Information Commissioner's Office, among others.[181] These efforts, despite

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177 *Ethical Guidelines for Trustworthy AI*, EUROPEAN AI ALLIANCE (Mar. 28, 2019), https://ec.europa.eu/futurium/en/node/6945.

178 *But see* Daly et al., *supra* note 163, at 12 (noting that "A member of the High-Level Expert Group, Thomas Metzinger, criticized the process and output as 'ethics washing' in an op-ed for German newspaper Der Tagesspeigel in 2019. In particular he pointed to the removal of 'red line' 'non-negotiable' text from the final version of the Guidelines as an example of this, and called for academia and civil society to take charge of the discussion on AI governance and ethics, especially away from industry.").

179 *Id.*

180 *Id.* ("The Panel calls for more work to be done to assess existing legal and regulatory frameworks to discern whether they are adequate to address the Panel's recommendations or whether reform is necessary in order to do so, with particular regard being paid to: the monitoring and restriction of automated lethal weapons; the monitoring of personalised AI systems built on children's profiles; and the monitoring of AI systems used in the private sector which significantly impact on human lives, with the possibility of introducing further obligations on such providers.").

181 *Project ExplAIn: Interim Report*, INFO. COMM'R'S OFF. (U.K.), https://ico.org.uk/media/about-the-ico/documents/2615039/project-explain-20190603.pdf (last visited Sept. 4, 2020); *An Overview of the Auditing Framework for Artificial Intelligence and its Core Components*, INFO. COMM'N OFF. (Mar. 26, 2019), https://ai-auditingframework.blogspot.com/2019/03/an-overview-of-auditing-framework-for_26.html; *See* Daly et al., *supra* note 163, at 13–14. In addition to the EU, the Council of Europe (which includes EU Member States along with

notable differences especially at the national level, together form an integrated view of AI governance that puts human rights and consumer control front and center in a manner that it distinct from particularly the Chinese approach to AI governance, introduced next.

C. China

Similar to the efforts in Europe, countries in Asia are also exploring the implications and developing guidelines around AI. Singapore's Model Governance Framework, for example, is arguably the best example of such an effort, providing an "accountability-based Model Framework" to help chart the language and "frame the discussions around . . . harnessing AI in a responsible way."[182] China's economic reach, though, and its high degree of state-supported AI governance and ethics initiatives underscore the extent to which it deserves special attention.[183] In particular, in 2017 China's State Council published the "New-Generation AI Development Plan" with the goal of making China a "world leader in AI innovation."[184] To accomplish this feat, the policy underscores the need for China to participate in global AI standards setting and "deepen[ ] international cooperation in AI laws and regulations."[185] To operationalize this goal, the 2019 Beijing AI Principles were published by the Beijing Academy of Artificial Intelligence highlighting the goal, similar to language used by the EU discussed above, of developing AI to benefit "humankind and nature."[186] The risks of AI in the report also mirror many of those discussed in Part I, including displaced workers and unemployment while avoiding a "malicious AI race" and have been supported by key Chinese stakeholders including various universities along with leading companies such as Baidu, Alibaba, and Tencent.[187]

A related effort to the Beijing AI Principles is China's Ministry of Industry and Information Technology (MIIT), which released a Joint Pledge on Self Discipline in the Artificial Intelligence Industry in

non-EU nations from eastern Europe including Russia and Turkey) has taken on specific issues in the AI context, such as in the judiciary and online dispute resolution in particular (2018 European Commission for the Efficiency of Justice (CEPEJ) European Ethical Charter on the Use of Artificial Intelligence (AI) in Judicial Systems and Their Environment), and as applied to big data (2019 Guidelines on Artificial Intelligence and Data Protection to the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data). *Id.*

182 *A Proposed Model Artificial Intelligence Governance Framework*, PERS. DATA PROT. COMM'N SING. (Jan. 2019), https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE4u7Mv.

183 *See* Daly et al., *supra* note 163, at 18.

184 *Id.*

185 *Id.*

186 *Id.*; *Beijing AI Principles*, *supra* note 158.

187 Daly et al., *supra* note 163, at 18.

2019.[188] Although it was not yet finalized as of this writing, the language does speak to the importance of meshing AI governance with "broader trends in Chinese digital governance."[189] A more fleshed out effort is the Chinese Government Ministry of Science and Technology, which released eight "Governance Principles for the New Generation Artificial Intelligence: Developing Responsible Artificial Intelligence in June 2019."[190] Similar to the Beijing AI Principles, international cooperation is emphasized, along with the "full respect" for other nations to pursue AI development while stressing the need for "agile governance" to quickly respond to given problems in a timely manner.[191] This refrain could be in reference to the oftentimes slow pace of regulatory responses to AI governance challenges, and was also a term used in the EU's High-Level Expert Panel introduced above, though it was not included as a final principle.[192] Similar to the private initiatives discussed above, Chinese firms including Tencent also have private AI codes of conduct, though it is unclear whether the firm has an internal board to enforce the policy.[193]

Together, the Chinese approach to AI governance, then, demonstrates similarities with the European stance, in particular as it relates to the need for an international, human-centered, agile approach to governance, though clearly one with a larger role for the State as distinct from the more distributed European or U.S. efforts.

D. International Law & Organizations

It should come as little surprise that there are few international laws that impact the development or deployment of AI generally. Emblematic of the problem is the United States and Russia blocking a 2018 effort to reform the UN Convention on Certain Conventional Weapons to "prohibit fully autonomous lethal weapons."[194] Yet there are specific efforts underway to change this fact, such as proposing new regimes to govern "automation, personhood, weapons systems, control, and standardiza-

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188 *Id.*; Graham Webster, *Translation: Chinese AI Alliance Drafts Self-Discipline 'Joint Pledge'*, NEW AM. (June 17, 2019), https://www.newamerica.org/cybersecurity-initiative/digichina/blog/translation-chinese-ai-alliance-drafts-self-discipline-joint-pledge/?from=timeline&isappinstalled=0.

189 Daly et al., *supra* note 163, at 18.

190 *Id.*; Lorand Laskai & Graham Webster, *Translation: Chinese Expert Group Offers 'Governance Principles' for 'Responsible AI'*, NEW AM. (June 17, 2019), https://www.newamerica.org/cybersecurity-initiative/digichina/blog/translation-chinese-expert-group-offers-governance-principles-responsible-ai/.

191 Laskai & Graham, *supra* note 190

192 Daly et al., *supra* note 163, at 19.

193 *Id.*

194 *Id.* at 9.

tion[,]" to name a few.[195] Other commentators, such as Professor Dan Jerker B. Svantesson, have proposed harnessing private international law to regulate "'weak' to 'moderate' AI."[196] An array of international institutions are available to help catalyze new governance structures. These include UNICEF, the UN Development Program (through the multi-stakeholder Partnership on AI[197]), the UN Interregional Crime and Justice Institute through its new Centre for Artificial Intelligence and Robotics, the World Economic Forum through its Center for the Fourth Industrial Revolution, along with various technical initiatives.[198] For the latter, the Institute of Electrical and Electronic Engineers (IEEE's) Global Initiative on Ethics of Autonomous and Intelligent Systems has produced "Ethically Aligned Design" to help "guide the ethical design, development and implementation of autonomous and intelligent systems."[199]

Nations around the world, from the United States to China and Russia, are aware of the potential for AI to catapult their economies and impact national security. Increasingly, just as the US is exploring the possible challenges presented by AI, international communities as well as specific nations are exploring ways to limit the negative impact of AI on individuals. For example, the OECD has passed AI principles for responsible stewardship of trustworthy AI and national policies and international cooperation for trustworthy AI,[200] supported by over 40 countries and endorsed by the G20 (the latter of which, it should be said, includes China and Russia).[201] Other related efforts include the 2018 Declaration on Ethics and Data Protection in Artificial Intelligence,

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195 Thomas Burri, *International Law and Artificial Intelligence*, 60 GER. YEARBOOK OF INT'L L. 91, 91–92 (2017).

196 Dan Jerker B. Svantesson, *A Vision for the Future of Private International Law and the Internet – Can Artificial Intelligence Succeed Where Humans Have Failed?*, HARV. INT'L L.J. (2019), https://harvardilj.org/2019/08/a-vision-for-the-future-of-private-international-law-and-the-internet-can-artificial-intelligence-succeed-where-humans-have-failed/. *See generally* Sasha Radin, *Expert Views on the Frontiers of Artificial Intelligence and Conflict*, INT'L COMM. RED CROSS (Mar. 19, 2019), https://blogs.icrc.org/law-and-policy/2019/03/19/expert-views-frontiers-artificial-intelligence-conflict/ (discussing international law as applied to AI and conflict).

197 The Partnership on AI includes "some UN agencies . . . among its members, as well as NGOs (such as Article 19), academic research institutes (such as the Australian National University 3Ai Centre), public sector agencies (including the BBC) and also technology firms such as Amazon but also Chinese giant Baidu." Daly et al., *supra* note 163, at 10.

198 *Id.* at 9–10.

199 *Id.* at 9.

200 *Recommendation of the Council on Artificial Intelligence*, OECD (May 21, 2019), https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449.

201 *G20 Ministerial Statement on Trade and Digital Economy*, G20, https://www.mofa.go.jp/files/000486596.pdf (last visited Sept. 4, 2020).

which calls for the establishment of "common governance principles" for AI.[202]

E. Summary

The scattering of private and public initiatives surveyed here may be conceptualized as an "AI Regime Complex," which is "a collective of partially overlapping and non-hierarchical regimes"[203] that vary in extent and purpose. Yet, there also remains a relatively paucity of guidelines and procedural or performance standards (known as the global "invisible infrastructure"),[204] as we have noted. Why might this be? According to author David Bollier:

> The void in AI governance may have many explanations: the sheer speed of AI innovation and the uncertain pathways it will take; the disruptive and complicated ramifications that elected officials might rather avoid; the chronic difficulty in coordinating diverse laws . . .; and general industry resistance to the very idea of government regulation.[205]

If true, it is important to consider the bounds of self-regulation in the AI context, which is attempted next using the lens of polycentric governance.

IV. TOWARD A POLYCENTRIC MODEL FOR AI GOVERNANCE

The concept of polycentric governance is multi-faceted and enjoys a long, and storied—if perhaps enigmatic—history that was developed so as to better "understand the emergence, change, and performance of complex governance systems."[206] Although a variety of scholars including Professors Michael Polanyi and Lon Fuller deserve credit for creating the field,[207] Vincent and Elinor Ostrom did much to jumpstart popular interest and to provide it with empirical depth.[208] Overall, the concept

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202 Daly et al., *supra* note 163, at 9.

203 Kal Raustiala & David G. Victor, *The Regime Complex for Plant Genetic Resources*, 58 INT'L ORG. 277, 277 (2004); *See also* Daniel H. Cole, *Advantages of a Polycentric Approach to Climate Change Policy*, 5 NATURE CLIMATE CHANGE 114, 114 (2015) (noting that Victor and Raustiala argued in favor of regime complexes several years before Keohane and Victor made similar arguments in the climate change context).

204 Radhika Gorur, *The Invisible Infrastructure of Standards*, 54 CRITICAL STUD. EDUC. 132, 132–33 (2012) (standards can be particularly helpful in harmonizing processes, enhancing transparency, providing a basis for third-party verification, and informing regulatory reforms).

205 Bollier, *supra* note 29, at 24–25.

206 Christoph Oberlack et al., *Polycentric Governance in Telecoupled Resource Systems*, 23 ECOLOGY & SOC'Y 16, 16 (2018).

207 *See* Paul D. Aligica & Vlad Tarko, *Polycentricity: From Polanyi to Ostrom, and Beyond*, 25 GOVERNANCE 237, 237 (2012).

208 *See* Carlisle & Gruby, *supra* note 14, at 928.

denotes "a complex form of governance with multiple centers of decision making, each of which operates with some degree of autonomy."[209] Vincent Ostrom famously defined polycentric governance as: "A pattern of organisation where many independent elements are capable of mutual adjustment for ordering their relationships with one another within a general system of rules."[210] It can (and has) been applied to a multitude of contexts, though primarily with regards to "small-scale, community-based resource systems."[211] Yet it has also been seen as increasingly helpful in managing an array of global collective action problems from climate change to cyber attacks given the diffusion of power globally to an increasingly multipolar, or even nonpolar, world order.[212] Moreover, polycentric governance can be especially useful in both identifying governance gaps, and providing insights for what to do about them across a range of contexts, from climate change to reforming the European Union.[213]

The notion of such a multi-stakeholder, multi-sector, multi-scale, multidisciplinary approach to governing AI has a great deal of appeal given the rich—if incomplete—array of private and public initiatives cropping up all over the world as was discussed in Part III. A key component of polycentric governance, though certainly not the central or sole feature, is to provide the capacity for nested self-governance.[214] This jives well with the findings from Part III, in particular the extent to which private governance is becoming the new, major global power center.[215] As we have shown, a wide array of firm-specific AI principles, and industry codes of conduct, are being created as is true across a wide range of other contexts including the environment,[216] but what does the literature tell us about whether these will be influential and effective?

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209 *Id.*

210 VINCENT OSTROM, POLYCENTRICITY 21 (1972).

211 Carlisle & Gruby, *supra* note14, at 927.

212 *See, e.g.*, Scott J. Shackelford, *On Climate Change and Cyber Attacks: Leveraging Polycentric Governance to Mitigate Global Collective Action Problems*, 18 VAND. J. ENT. & TECH. L. 653, 658 (2016); Richard N. Haass, *The Age of Nonpolarity: What Will Follow U.S. Dominance*, 87 FOREIGN AFF. 44, 44 (2008).

213 *See, e.g.*, HARRIET BULKELEY & PETER NEWELL, GOVERNING CLIMATE CHANGE (2010); POLYCENTRICITY IN THE EUROPEAN UNION (Josephine van Zeben & Ana Bobic eds., 2019).

214 TIM BÜTHE & WALTER MATTLI, THE NEW GLOBAL RULERS: THE PRIVATIZATION OF REGULATION IN THE WORLD ECONOMY 25 (2011).

215 *See id.* at 5, 18.

216 *See* Matthew Potoski & Aseem Prakash, *Green Clubs and Voluntary Governance: ISO 14001 and Firms' Regulatory Compliance*, 49 AM. J. POL. SCI. 235, 236 (2005).

One framing device to consider is to think of voluntary self-regulation as a type of club good that is "available to some, but not all."[217] Such clubs—such as the IEEE or the Partnership on AI—"provide nonrival but potentially excludable benefits to members."[218] Such benefits can include boosts to a given brand's reputation, as seen in the environmental context,[219] such as by associating a given software firm with ethical design best practices. For example, one study found that U.S. facilities that joined the voluntary ISO 14001 improved "compliance with government regulations" given its "broad positive standing with external audiences."[220] Such findings point to the need for new international standards for AI, an idea discussed further below.[221]

But success is not guaranteed even in polycentric systems. Some efforts have been made, for example, to explore the contours of "functional" polycentric systems.[222] For example, such criteria might include the capacity of such systems to "adapt when faced with social and environmental change," "provide [a] good institutional fit" given the nature of the governance challenges in play, and that they "mitigate the risk of institutional failure" due to the redundancy built in with multiple scales of decision makers.[223] We explore this element of redundancy at multiple levels below in the context of a layered approach to hybrid AI governance. First, though, it is important to note that polycentric systems "do not necessarily perform well or better than other forms of governance" due to an array of problems including high transaction costs associated with collaborating at such diverse scales (especially globally),[224] and a lack of clear accountability given the multitude of stakeholders involved (as discussed in the AI context above).[225] To overcome these challenges and realize the benefits of polycentric systems, an array of "enabling conditions" have been suggested. These include: the need for decision-making centers to "employ diverse institutions," "exist at different levels and across political jurisdictions," and the presence of "[g]enerally applicable rules and norms . . . within the system," along with mechanisms for accountability and conflict resolution.[226]

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217 *See* Joseph S. Nye, Jr., *The Regime Complex for Managing Global Cyber Activities* 3, 1 GLOBAL COMMISSION ON INTERNET GOVERNANCE PAPER SERIES, May 2014, https://dash.harvard.edu/bitstream/handle/1/12308565/Nye-GlobalCommission.pdf.

218 Potoski & Prakash, *supra* note 216, at 235.

219 *Id.*

220 *Id.*

221 *See* Robert Bartram, *The New Frontier for Artificial Intelligence*, ISO, Oct. 18, 2018, https://www.iso.org/news/ref2336.html.

222 Carlisle & Gruby, *supra* note 14, at 929.

223 *Id.*

224 *Id.*

225 *Id.*

226 *Id.* at 937.

Several of these enabling conditions mirror the Design Principles from Elinor Ostrom's 1990 book, *Governing the Commons*, which calls for: (1) "clearly defined boundaries for the user pool . . . and the resource domain";[227] (2) "proportional equivalence between benefits and costs";[228] (3) "collective choice arrangements" ensuring "that the resource users participate in setting . . . rules";[229] (4) "monitoring . . . by the appropriators or by their agents";[230] (5) "graduated sanctions" for rule violators;[231] (6) "conflict-resolution mechanisms [that] are readily available, low cost, and legitimate";[232] (7) "minimal recognition of rights to organize";[233] and (8) "governance activities [being] . . . organized in multiple layers of nested enterprises."[234] Although developed for a different context (namely the governance of local common pool resources), the insights gleaned from these enabling conditions and design principles are vital to building a successful polycentric model of hybrid governance for AI, which may be understood as rules and compliance with those rules being set by a range of NGOs, such as industry associations, often in collaboration with government.[235] In particular, it is the importance of both *interaction* and *coordination* across multiple stakeholders that differentiates successful polycentric systems from fragmented regimes.[236]

These ideas are already being operationalized: "While the exact contours of a future AI governance model are still in flux, advanced governance models such as active matrix theory, polycentric governance, hybrid regulation, and mesh regulation can provide both inspiration and conceptual guidance on how such a future governance regime might be designed."[237] Various models have been proposed to help conceptualize AI governance. For example, Figure 1 offers a "layered approach" that makes use of the literature discussed above focusing on: "social and legal; ethical; and technical foundations that support the ethical and social

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227 SUSAN J. BUCK, THE GLOBAL COMMONS: AN INTRODUCTION 32 (1998).

228 *See* ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 90 (1990).

229 BUCK, *supra* note, 227, at 32.

230 *Id.*

231 *Id.*

232 *Id.*

233 *See* Elinor Ostrom, *Polycentric Systems: Multilevel Governance Involving a Diversity of Organizations*, *in* GLOBAL ENVIRONMENTAL COMMONS: ANALYTICAL AND POLITICAL CHALLENGES INVOLVING A DIVERSITY OF ORGANIZATIONS 105, 118 tbl.5.3. (Eric Brousseau et al. eds., 2012).

234 *Id.*

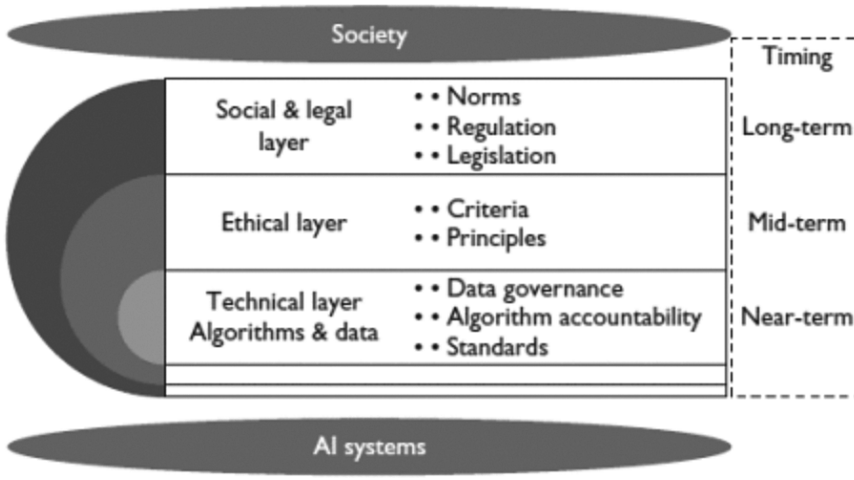
235 *Id.*

236 *See* Tanya Heikkila, *Bringing Polycentric Systems into Focus for Environmental Governance*, ENVTL POL'Y & GOVERNANCE 207, 208–09 (2018).

237 Urs Gasser & Virgilio A.F. Almeida, *A Layered Model for AI Governance*, 21 IEEE INTERNET & COMPUTING 58, 60 (2017).

layers."[238] In brief, the technical layer comprises the algorithmic foundation of "the AI governance ecosystem"[239] that, in turn, run the physical (including AVs) and software systems ("criminal justice or medical diagnostic")[240] referenced above. The various principles introduced in Part III can help ensure good governance in the technical layer, including efforts to promote accountability through: "responsibility, explainability, accuracy, auditability, and fairness."[241]

FIGURE 1: A "LAYERED" APPROACH TO AI GOVERNANCE[242]



Following from the Technical Layer, the Ethical Layer seeks to ensure the realization of ethical principles in the design and application of AI systems. A key aspect of this is human rights, which arguably include both a right to privacy and cybersecurity in the digital age.[243] An application of this work is the IEEE General Principles for AI and Autonomous Systems mentioned in Part III, which are designed to promote—among other things—equal and fair treatment.[244] Finally, the proposed Social and Legal Layer would focus on organizing, revising, and creating institutions at the local, national, and international levels to govern AI systems.[245] Various ideas have been proposed in this regard as we explore further in Part IV, such as creating a policymaking "AI Authority" that

238 *Id.* at 5.
239 *Id.*
240 *Id.*
241 *Id.* at 1.
242 *Id.*
243 For more on this topic, see Scott J. Shackelford, *Should Cybersecurity Be a Human Right? Exploring the 'Shared Responsibility' of Cyber Peace*, 55 STAN. J. INT'L L. 155, 156 (2019).
244 Gasser & Almeida, *supra* note 32, at 6.
245 *Id.*

would regulate AI research in some areas such as by requiring that researchers be subject to strict liability, with the norms being identified from the Technical and Ethical Layers along with other pre-existing legal regimes explored in Parts II and III.[246]

Such a layered approach to conceptualizing a polycentric AI governance system has parallels with other frameworks stemming from the Design Principles, including the Institutional Analysis and Development (IAD), Social-Ecological-Systems (SES), and Governing Knowledge Commons (GKC) Frameworks.[247] Space constraints prohibit a deep exploration of how these frameworks could apply to AI, but the foundation has been laid in the cybersecurity and Internet of Things (IoT) contexts.[248] Suffice it to say, "thinking polycentricly"[249] about AI governance holds significant advantages over alternative models, though it is by no means a panacea as is explored further in the context of Autonomous Vehicles.

V. AI GOVERNANCE CASE STUDY: AUTONOMOUS VEHICLES

In an effort to drill down more on the specifics for how these varying approaches to AI governance that have been explored throughout the Article are having real-world impacts, this Part focuses squarely on the issue of regulating Autonomous Vehicles (AVs). Many automakers, including Tesla, Ford, GM, and BMW, for example, have "disclosed cyber risks to their investors."[250] Fixes, such as Internet "kill switches" that would make it possible for drivers to take back control of their vehicles during a cyber-attack, have yet to be implemented.[251] Mirroring the structure used above, overarching issues are introduced, followed by a brief summary for how the main actors discussed throughout—the U.S., EU, and China—are approaching this topic using the lens of polycentric governance to glean both lessons learned and next steps, which are fleshed out in Part VI.

In general, AVs are "an apt metaphor for what we're dealing with—technology is moving into the driver's seat as a primary determinant of humanity's destiny. We are being challenged as to whether we can shape

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246 *See id.*

247 *See* BEATRICE MOSELLO, HOW TO DEAL WITH CLIMATE CHANGE? INSTITUTIONAL ADAPTIVE CAPACITY AS A MEANS TO PROMOTE SUSTAINABLE WATER GOVERNANCE 31 (2015).

248 *See, e.g.*, SCOTT J. SHACKELFORD, GOVERNING NEW FRONTIERS IN THE INFORMATION AGE: TOWARD CYBER PEACE (2020); Scott J. Shackelford, *Governing the Internet of Everything*, 37 CARDOZO ARTS & ENT. L. J. 701 (2019).

249 GOVERNING COMPLEXITY: ANALYZING AND APPLYING POLYCENTRICITY 3 (Andreas Thiel, William A. Blomquist, & Dustin E. Garrick eds., 2019).

250 Eric D. Lawrence, *Reports Warns of Possible Mass Casualties from Automotive Cyberattacks*, USA TODAY (Aug. 1, 2019, 1:46 PM), https://www.usatoday.com/story/money/cars/2019/08/01/auto-cyberattacks-mass-casualties-consumer-watchdog/1889808001/.

251 *Id.*

the trajectory of that future to some degree, with relatively weak tools."[252] The benefits of this technology are widespread, including more efficient, cost-effective, and safer transportation options adding up to more than $800 billion in economic gains by some estimates,[253] but so, too, are the risks,[254] including those to cybersecurity.[255] As is apparent from Parts II–III, governments have been reluctant to place onerous regulatory requirements on AI firms due to the risk of stilling the pace of innovation in such a strategic industry.[256] Consequently, the regulations that have been imposed have been insufficient to manage these multifaceted risks.[257] Thus far, as is explored below, the United States has been focused on safety issues with AVs generally, while the EU has been more interested in cybersecurity and privacy concerns—all countries have afforded far less attention than might be apparent to environmental or employment risks associated with AVs.

A. U.S. Approach to AV Governance

Federal efforts to govern AVs in the United States have focused mostly on the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration.[258] Attention has focused on relaxing the current Federal Motor Vehicle Safety Standards (FMVSS) regulations, which, to date, have been unsuccessful.[259] Similarly, legislative reforms have failed to pass. The SELF DRIVE Act, for example, was meant to lay out a basic federal framework on AV regulation and address the patchwork regulation between States.[260] It was also

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252 Bollier, *supra* note 29, at 2.

253 *See* Skip Descant, *Autonomous Vehicles to Have Huge Impact on Economy, Tech Sector*, GOVTECH (June 27, 2018), https://www.govtech.com/fs/automation/Autonomous-Vehicles-to-Have-Huge-Impact-on-Economy-Tech-Sector.html.

254 Ortwin Renn & Christina Benighaus, *Perception of Technological Risk: Insights from Research and Lessons for Risk Communication and Management*, 16 J. RISK RES. 293, 294 (2012).

255 *See* Barry Sheehan et al., *Connected and Autonomous Vehicles: A Cyber-Risk Classification Framework*, 124 TRANSP. RESEARCH PART A: POL'Y & PRAC. 523 (2019).

256 Ashley Halsey III, *'We're listening,' Department of Transportation says on the Future of Driverless Cars*, WASH. POST (Mar. 1, 2018), https://www.washingtonpost.com/local/trafficandcommuting/were-listening-department-of-transportation-says-on-the-future-of-driverless-cars/2018/03/01/8992682a-1d72-11e8-b2d9-08e748f892c0_story.html?noredirect=on.

257 *See* Araz Taeihagh & Hazel Si Min Lim, *Governing Autonomous Vehicles: Emerging Responses for Safety, Liability, Privacy, Cybersecurity, and Industry Risks*, TRANSP. REV. (June 23, 2018), https://arxiv.org/ftp/arxiv/papers/1807/1807.05720.pdf.

258 *Autonomous Vehicles: US Legal and Regulatory Landscape*, DENTONS (July 31, 2019), https://www.dentons.com/en/insights/guides-reports-and-whitepapers/2019/july/31/autonomous-vehicles-us-legal-and-regulatory-landscape.

259 *Id.*

260 Aarian Marshall, *Congress Unites (Gasp) to Spread Self-Driving Cars Across America*, WIRED (Sept. 6, 2017), https://www.wired.com/story/congress-self-driving-car-law-bill/.

meant to require "privacy plans" on how manufacturers collect, use and store data from vehicles.[261] The bill passed the House, but its Senate complement, the AV START Act, failed to gather enough votes in the Senate and expired.[262] Other attempts have included the SPY Car Act of 2019,[263] which was meant to establish cybersecurity standards for all vehicles and better inform consumers in an easy-to-understand trust mark through NHTSA.[264] As of this writing, though, neither bill has passed congressional scrutiny.[265]

Federal inaction has resulted in efforts to regulate AVs from state-level initiatives.[266] In total, as of mid-2019, forty-one states have considered AV regulation, either through legislation or executive order.[267] Yet, it has been rare for these initiatives to address outstanding privacy and cybersecurity concerns, unlike in the EU (explored next).[268] It also means that jurisdictions are incentivized to be lax so as to lure AV firms; Virginia, for example, has no specific AV regulations and has even offered state support—including a designated highway corridor for AV testing.[269] Overall, AV regulation remains fragmented in the United States, as with AI governance generally as we explored in Part II, with relatively little evidence of the coordination necessary for a successful polycentric system.

B. EU Approach to AV Governance

It should come as little surprise that the European Union is notably stricter with AVs than the United States—as with AI governance writ

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261 *Id.*

262 Andrew J. Hawkins, *Congress Takes Another Stab at Passing Self-Driving Car Legislation*, THE VERGE (July 28, 2019), https://www.theverge.com/2019/7/28/8931726/congress-self-driving-car-bill-redo-2019.

263 SPY Car Act of 2019, S. 2182, 116th Cong., § 2; Christopher H. Grigorian & R. Nicholas Englund, *Congress Taking Another Look at Regulating Automated Driving Systems*, FOLEY & LARDNER LLP (Sept. 10, 2019), https://www.foley.com/en/insights/publications/2019/09/congress-look-regulating-automated-driving-systems ("The bill would direct NHTSA and the Federal Trade Commission ('FTC') to establish standards that address cybersecurity threats and protect drivers' privacy. The bill would create cybersecurity standards that would require all new vehicles to have 'reasonable [security] measures. . . .'").

264 *See* Benjamin L. Bollinger, *The Security and Privacy In Your Car Act: Will It Actually Protect You?*, 18 N.C. J. OF L. & TECH. 214, 214 (2017); Edward J. Markey, *S.2182 SPY Car Act of 2019*, Congress.gov (July 2019), https://www.congress.gov/bill/116th-congress/senate-bill/2182/text.

265 Grigorian & Englund, *supra* note 263

266 Lester, *supra* note 118.

267 *Autonomous Vehicles*, *supra* note 258.

268 EUROPEAN PARLIAMENT RESOLUTION OF 23 APRIL 2009 ON THE INTELLIGENT TRANSPORT SYSTEMS ACTION PLAN, EU (Apr. 23, 2009) [hereinafter European Parliament resolution].

269 *Virginia Automated Corridors*, VA. TECH TRANSP. INST., https://www.vtti.vt.edu/facilities/vac.html (last visited Oct. 18, 2019).

large. The EU largely confines AV testing to private streets and predefined routes, or they test at very low speeds.[270] The EU has adopted the amended 1968 UN Vienna Convention on Road Traffic, an accord meant to create consistent traffic regulation across borders and replace the 1949 UN Geneva Convention on Road Traffic.[271] One of the fundamental principles of the Convention is that the driver is always fully in control and responsible for the vehicle; AVs are an obvious challenge to this stipulation.[272] In 2016, the Convention was updated to allow driverless technologies on European roads, though drivers must be ready to take back control of the vehicle.[273] Some countries (like some U.S. states) have done more, with Germany going so far as to legalize AVs on all their roads.[274] The Netherlands has taken it a step further, allowing the testing of AVs without the physical presence of human drivers.[275]

As has been noted, the EU has also been much more proactive than the United States when it comes to AV privacy and cybersecurity. The EU's Intelligent Transport Systems (ITS) Action Plan, for example, evokes many GDPR protections, such as robust requirements for consent that were discussed in Part III, but it is not explicitly tailored for AVs.[276] Similarly, the EU has created a "Cyber-security package" to increase EU resilience to cyber-attacks, promote an effective criminal law response, and strengthen global stability through international cooperation, including with the other AI superpower—China.[277]

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270 Stefan Nicola, Elisabeth Berhmann & Marie Mawad, *It's a Good Thing Europe's Autonomous Car Testing Is Slow*, BLOOMBERG (Mar. 20, 2018), https://www.bloomberg.com/news/articles/2018-03-20/it-s-a-good-thing-europe-s-autonomous-car-testing-is-slow.

271 *50 Years on, the 1968 Conventions on Road Traffic and Road Signs and Signals are Still at the Core of Road Safety Efforts Worldwide*, UNECE (Nov. 8, 2018), https://www.unece.org/info/media/presscurrent-press-h/transport/2018/50-years-on-the-1968-conventions-on-road-traffic-and-road-signs-and-signals-are-still-at-the-core-of-road-safety-efforts-worldwide/doc.html.

272 Susanne Pillath, *Automated Vehicles in the EU*, EUR. PARLIAMENT THINK TANK (July 1, 2016), http://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2016)573902.

273 *UNECE Paves the Way for Automated Driving by Updating UN International Convention*, UNECE (March 23, 2016), https://www.unece.org/info/media/presscurrent-press-h/transport/2016/unece-paves-the-way-for-automated-driving-by-updating-un-international-convention/doc.html.

274 Christiaan Hetzner, *German Industry Welcomes Self-Driving Vehicles Law*, AUTOMOTIVE NEWS EUR. (May 15, 2017), https://europe.autonews.com/article/20170515/ANE/170519866/german-industry-welcomes-self-driving-vehicles-law.

275 *Netherlands: Legislation to Allow More Testing of Driverless Vehicles,* LIBR. CONG. (Mar. 29, 2017), http://www.loc.gov/law/foreign-news/article/netherlands-legislation-to-allow-more-testing-of-driverless-vehicles/.

276 EUROPEAN PARLIAMENT RESOLUTION, *supra* note 268.

277 *The EU Cybersecurity Certification Framework*, EU (June 2019), https://ec.europa.eu/digital-single-market/en/eu-cybersecurity-certification-framework; *see also Legislative Train: Cyber-security package*, EU (Nov. 2020), https://www.europarl.europa.eu/legislative-train/theme-connected-digital-single-market/file-cyber-security-package.

C. Chinese Approach to AV Governance

As in the United States, China has been reticent in regulating AVs given its aspirations to be a world leader in AI, as was discussed in Part III.[278] In fact, the relatively few regulations passed by China largely focus on fostering AVs, similar to Virginia.[279] In 2016, the country initiated its China-New Car Assessment Program to ensure that safety measures were incorporated (again, similar to the U.S. FMVSS regulations) and began research on industry policy and stakeholder engagement.[280] As for cybersecurity and privacy protections, China now requires the anonymization of personal information (somewhat similar to GDPR protections), highlighting consumer consent and network transparency,[281] even as other elements of the 2017 Chinese Cybersecurity Law require data localization and that firms "assist governmental-party agencies involved in national and public security."[282] The stiff requirements make it difficult for companies to meet China's privacy standards, and pose a challenge for firms both inside and outside of the AV industry.[283]

D. Other Notable International AV Governance Actions

The Ministers of Transport of the G7 called for cooperation on data protection and cybersecurity in their Declaration on Automated and Connected Driving.[284] Because of this, the UN worked to identify eighty-six threats to cybersecurity and considered how to prevent or mitigate these threats in the context of AVs.[285] In December 2017, it created the Task

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278 Sarah Dai, *'Made in China 2025': China has a Competitive AI Game Plan but Success Will Need Cooperation*, S. CHINA MORNING POST (Oct. 1, 2018), https://www.scmp.com/tech/article/2166177/made-china-2025-china-has-competitive-ai-game-plan-success-will-need.

279 *Id.*; *Autonomous Vehicles*, *supra* note 258.

280 *Automated Driving Roadmap*, ERTRAC (May 29, 2017), https://www.ertrac.org/uploads/images/ERTRAC_Automated_Driving_2017.pdf.

281 *Overview of China's Cybersecurity Law*, KPMG (Feb. 2017), https://assets.kpmg/content/dam/kpmg/cn/pdf/en/2017/02/overview-of-cybersecurity-law.pdf

282 Israel Kanner & Doran Ella, *China's New Cybersecurity Law*, INST. NAT'L SEC. STUD. (Apr. 3, 2017), https://www.inss.org.il/publication/chinas-new-cybersecurity-law/; Dan Swinhoe, *What are the New China Cybersecurity Law Provisions? And How CISOs Should Respond*, CSO (Mar. 11, 2019), https://www.csoonline.com/article/3359236/what-is-the-china-cybersecurity-law-how-cisos-should-respond.html.

283 Simone McCarthy, *Will China's Revised Cybersecurity Rules Put Foreign Firms at Risk of Losing Their Secrets?*, S. CHINA MORNING POST (Oct. 13, 2019), https://www.scmp.com/news/china/diplomacy/article/3032649/will-chinas-revised-cybersecurity-law-put-foreign-firms-risk.

284 *G7 Declaration on Automated and Connected Driving*, Federal Industry of Transport and Digital Infrastructure (Feb. 8, 2018), https://www.bmvi.de/SharedDocs/EN/Documents/K/g7-declaration-on-automated-and-connected-driving.html.

285 *Major Results and Action Items of the Twelfth Meeting of Informal Group on "ITS/Automated Driving*", UNECE (Nov. 16, 2017), https://wiki.unece.org/pages/viewpageattachments.action?pageId=54427891 (seventh link under "Attachments").

Force for Cyber-Security and Over-the-Air issues and created best practices for cybersecurity.[286]

Other jurisdictions, such as Singapore mentioned above, have also been leaders in AI governance. That nation in particular is planning to deploy autonomous buses by 2022.[287] To meet this goal, Singapore amended its Road Traffic Act in 2017 to permit motor vehicles without drivers.[288] The amendment also allows the Minister for Transport to create new AV rules and established a five-year regulatory sandbox, which is meant to preserve innovation, demonstrating one way to address the dilemma faced by governments of regulating AV while still allowing flexibility for AV manufacturers.[289] Furthermore, Singapore has strong existing regulations regarding privacy and cybersecurity, such as the Personal Data Protection Act (PDPA) and the Computer Misuse and Cybersecurity Act, which has been applied to AVs.[290] The PDPA has since been amended to increase transparency regarding data collection and use.[291] Though intended for a different environment, the Computer Misuse and Cybersecurity Act strengthens businesses' response to computer-related offenses and could be relevant to the systems found in AVs.[292] Because many of these regulations already exist, Singapore has the advantage of adapting or amending pre-existing laws, rather than creating new legislation from a blank slate. Singapore has also taken steps beyond regulation and aims to raise cybersecurity awareness of cybersecurity by creating a national Defense Cyber Organization and becoming a leading

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286 *Id.*

287 Cristina Lago & Charlotte Trueman, *How Singapore is Driving the Development of Autonomous Vehicles*, CIO (Jan. 24, 2019), https://www.cio.com/article/3294207/how-singapore-is-driving-the-development-of-autonomous-vehicles.html#targetText=driverless%20car%20legislation&targetText=with%20the%20amendment%20to%20the,to%20widely%20adopt%20autonomous%20driving.

288 Road Traffic (Amendment) Act, 2017 (Act No. 10/2017) (Sing.).

289 Kyunghee Park & Krystal Chia, *Singapore Built a Dedicated Town for Self-Driving Buses*, BLOOMBERG (June 4, 2018), https://www.bloomberg.com/news/features/2018-06-04/singapore-built-a-town-to-test-autonomous-self-driving-vehicles.

290 Araz Taeihagh & Hazel Si Min Lim, *Governing Autonomous Vehicles: Emerging Responses for Safety, Liability, Privacy, Cybersecurity, and Industry Risks*, 39 TRANSPORT REVIEWS 103, 112–14 (July 11, 2018), https://www.tandfonline.com/doi/full/10.1080/01441647.2018.1494640.

291 *Response to Feedback on the Public Consultation on Approaches to Managing Personal Data in the Digital Economy*, PERS. DATA PROTECTION COMM'N SINGAPORE (2018), https://www.pdpc.gov.sg/-/media/Files/PDPC/PDF-Files/Legislation-and-Guidelines/PDPC-Response-to-Feedback-for-Public-Consultation-on-Approaches-to-Managing-Personal-Data-in-the-Dig.pdf.

292 Kevin Kwang, *Changes to Singapore's Cybercrime Law Passed*, CHANNEL NEWS ASIA (Apr. 3, 2017), https://web.archive.org/web/20181227004710if_/https://www.channelnewsasia.com/news/singapore/changes-to-singapore-s-cybercrime-law-passed-8712368.

cybersecurity service provider.[293] A final unique area that Singapore has been active in resolving is displacement of workers from AV. Since the government expressed interest in autonomous buses, there have been concerns about jobs such as professional drivers.[294] To address this issue, Singapore has committed to retrain displaced workers.[295]

E. Summary

In general, the governance of AV systems remains challenging, and none of the jurisdictions surveyed has been able to address the full range of safety, cybersecurity, and privacy concerns of AI while still providing a fruitful atmosphere for AV innovation as is shown in Table 3.

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293 Thambipillai Srikanthan, *Commentary: Cybersecurity is the Next Economic Battleground*, CHANNEL NEWS ASIA, (Apr. 2, 2017), https://www.channelnewsasia.com/news/singapore/commentary-cybersecurity-is-the-next-economic-battleground-8591642.

294 Rahul Razdan, *Singapore and Autonomous Vehicles—Interesting Lessons in Governance, Planning, and Safety,* FORBES (Mar. 1, 2020), https://www.forbes.com/sites/rahulrazdan/2020/03/01/singapore-and-autonomous-vehicles---interesting-lessons-in-governance-planning-and-safety/#472314cf5fe2.

295 Kevin Kwang, *Regulations in Place to Ramp Up Driverless Vehicle Trials in Singapore*, Channel News Asia (Feb. 7, 2017), https://web.archive.org/web/20180423172835if_/https://www.channelnewsasia.com/news/singapore/regulations-in-place-to-ramp-up-driverless-vehicle-trials-in-sin-7622038.

TABLE 3: SUMMARY OF AV GOVERNANCE INITIATIVES ACROSS SUVEYED JURISDICTIONS

	General	Safety	Cybersecurity and Privacy	Displaced Workers
United States	• States are the main drivers for regulation • 41/50 states. have AV regulation • Two failed federal attempts at governing AVs: SELF DRIVE Act & SPY Car Act	• Adhere to existing safety standards, namely the Federal Motor Vehicles Safety Standards • Restrict testing to certain conditions or areas	• SELF DRIVE Act would require "privacy plans" on data collection and use • SPY Car Act would establish cybersecurity standards and inform consumers	• No notable initiatives
European Union	• Adapt current regulations to fit AV environments • Approaches vary slightly from country to country	• Edited 1949 Geneva Convention on Road Traffic to allow AVs • Restrict testing to certain conditions or areas	• Intelligent Transport Systems Action Plan regulates cybersecurity standards, such as consent and the right to be forgotten • Cybersecurity Package increases resilience to cyberattacks and creates effective criminal laws	• No notable initiatives
China	• Limited AV regulations to encourage AV and reach the goal of being an AI leader by 2025 • Robust cybersecurity and privacy regulations, though not AV specific	• China-New Car Assessment Program ensures safety measures are well incorporated ○ Encourages research on industry policy and stakeholder engagement	• Cybersecurity Law requires anonymization of personal information, consumer consent, and network transparency ○ Strict rules present challenges for firms operating in China	• No notable initiatives
Singapore	• Adapt current regulations to fit AV environments • Robust regulations in cybersecurity and privacy • One of the only countries to address displaced workers	• Amended Road Traffic Act to allow Avs establishing a 5-year regulatory sandbox	• Adapted Personal Data Protection Act (PDPA) and Computer Misuse and Cybersecurity Act to AV environments ○ Requires increased transparency in data collection and use • Created national Defense Cyber Organization to raise awareness	• Intend to retrain displaced workers for higher value-added jobs

As AVs mature and near full adoption, topics such as cybersecurity, privacy, and job displacement will come to the forefront of issue areas. Development of regulations will follow suit, with organizations leveraging experience to create well-informed and uniform best practices. As this process unfolds, it will be important to implement the best practices from the field of polycentric governance explored more fully in Part VI to ensure that the benefits of this emerging regime complex are realized.

VI. IMPLICATIONS FOR MANAGERS AND POLICYMAKERS

This Article has underscored areas of convergence and divergence between the leading AI powers, with particular attention being paid to the United States, EU, and China. In many ways, the EU and China are ahead of the United States in AI governance, particularly in consideration of the ethical aspects discussed in Part III. However, owing to recent executive actions from the Trump administration, that could begin to change[296] In general, though, it is important to consider the lessons from polycentric governance as next steps are considered at the national, regional, and global levels. Broadly, this includes: (1) underscoring the need for nested decision-making centers across multiple sectors and governance scales; (2) agreeing on baseline norms; (3) working on mechanisms for accountability and conflict resolution; (4) promoting communication; and (5) encouraging interaction and coordination among stakeholders while incentivizing cross-sector spillovers.[297] Each area of reform will be discussed in turn.

NESTED DECISION-MAKING: The literature on polycentric governance underscores the importance of nested governance structures featuring collective choice arrangements in which key stakeholders are empowered to help establish rules-in-use.[298] In short, this means that governance should take place across "multiple layers of related . . . regimes."[299] This does not mean that fragmentation is desirable—far from it, as is explored below; in fact, this variable calls for collaboration between "larger institutions" that would "govern the interdependencies among smaller units."[300] As such, there is a vital role to be played in the context of AI governance by both leading AI powers of the U.S., EU, and China, along with organizations such as the OECD and IEEE discussed in Parts II and III. In particular, a case can be made that a higher-level coordination effort is important given the myriad applications of AI explored throughout this Article, up to an including an "AI Authority"

296 Angela Daly et al., *supra* note 163, at 20.
297 *See* Heikkila, *supra* note 236, at 208.
298 Ostrom, *supra* note 233, at 120.
299 *Id.* at 122.
300 *Id.*

discussed below. Ultimately, each AI application—as with a given business transaction—should be nested through layered trust mechanisms.

NORMS: As illustrated in Part III, there is both a need for new international standards for AI, and for a growing list of players and efforts working to fill in governance gaps.[301] Although lists of proposed norms vary, there seems to be growing agreement around certain "essential principles," including "ethics, transparency, fairness, and explainability."[302] Within this overarching rubric (chosen, perhaps, due to the ease with which it can be mathematically operationalized),[303] more specific AI norms include: (1) law (the need for AI applications to be consistent with existing legal regimes); (2) ethics (including prohibitions against "undue harm," echoing the beginnings of an AI precautionary principle); and (3) robustness (mechanisms permitting the above, including technical measures to effectuate safety—such as in the AV context—and explainability).[304] Regarding the former, applicable laws would include domestic and international legal regimes, including the UN Declaration on Human Rights.[305] Building from Table 1, there are numerous areas of convergence between both private initiatives and state practice from which to build, including: the need for AI to be socially beneficial, include accountability mechanisms, be transparent, and ethical.[306] Fol-

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301 *See* Robert Bartram, *The New Frontier for Artificial Intelligence*, ISO (Oct. 18, 2018), https://www.iso.org/news/ref2336.html.

302 Trisha Ray, *Formulating AI Norms: Intelligent Systems and Human Values*, OBSERVER RES. FOUND. (Sept. 2019), https://www.orfonline.org/research/formulating-ai-norms-intelligent-systems-and-human-values-55290/.

303 Daly et al., *supra* note 163, at 25.

304 Ray, *supra* note 302, at 3.

305 *See* MARK LATONERO, GOVERNING ARTIFICIAL INTELLIGENCE: UPHOLDING HUMAN RIGHTS AND DIGNITY, Data & Society (2018), at 8, https://datasociety.net/wp-content/uploads/2018/10/DataSociety_Governing_Artificial_Intelligence_Upholding_Human_Rights.pdf.

306 Christina Demetriades & Tom McLaughlan, *Responsible AI and Robotics*, ACCENTURE, https://www.accenture.com/gb-en/company-responsible-ai-robotics (last visited Sept. 7, 2020); *Building Responsible AI for Everyone*, GOOGLE: AI, https://ai.google/responsibilities/ (last visited Sept. 7, 2020); *Everyday Ethics for Artificial Intelligence*, IMB, https://www.ibm.com/watson/assets/duo/pdf/everydayethics.pdf (last visited Sept. 7, 2020); *Artificial Intelligence: The Public Policy Opportunity*, INTEL, https://blogs.intel.com/policy/files/2017/10/Intel-Artificial-Intelligence-Public-Policy-White-Paper-2017.pdf (last visited Sept. 7, 2020); *Responsible AI*, MICROSOFT, https://www.microsoft.com/en-us/ai/responsible-ai?activetab=pivot1%3aprimaryr6 (last visited Sept. 7, 2020); *Ethics and Governance of AI Initiative*, BERKMAN KLEIN CTR. (June 10, 2019), https://cyber.harvard.edu/projects/ethics-and-governance-ai-initiative (last visited Sept. 7, 2020); *Beijing AI Principles*, JOURNALISM AI (May 25, 2019), https://journalismai.com/2019/05/25/beijing-ai-principles-beijing-academy-of-artificial-intelligence-2019/ (last visited Sept. 7, 2020); *One Hundred Year Study on Artificial Intelligence (AI100)*, STAN. UNIV., https://ai100.stanford.edu/history-1 (last visited Sept. 7, 2020); *The Montreal Declaration for a Responsible Development of Artificial Intelligence: A Participatory Process*, UDEM NOUVELLES: Salle de Presse (Nov. 3, 2017), https://nouvelles.umontreal.ca/en/article/2017/11/03/montreal-declaration-for-a-responsible-development-of-artificial-intelligence/ (last visited Sept. 7, 2020); *Government Artificial Intelligence Readiness Index 2019*, OXFORD INSIGHTS, https://www.oxfordinsights.com/ai-readiness2019 (last

lowing polycentric principles, these norms should be nested and reinforced through an interlocking suite of governance structures agreed to by nations and the private sector.[307]

ACCOUNTABILITY & CONFLICT RESOLUTION: A key aspect of ensuring the utility and worth of AI norms is promoting accountability and efficient conflict resolution, as seen in both the Ostrom Design Principles along with the enabling conditions introduced in Part IV. Some jurisdictions are further ahead than others in promoting these goals, such as Japan's 2017 Draft AI R&D Guidelines for International Discussions, which "commit to nine principles, including accountability, privacy and ethics."[308] The efforts of these norm entrepreneurs should be copied and reinforced by other higher-level governance stakeholders, including the AI powers and the UN. Yet, to date, there have been relatively few governance reforms that are legally binding, with the exception of the 2019 U.S. Executive Order on AI.[309] Self-reinforcing AI codes of conduct—perhaps modeled on the European Commission's Code of Practice on Disinformation[310]—certainly have their place. Over time, however, efforts should be made to crystallize this industry and state practice into new laws and treaties, particularly to help avoid forum shopping, with stakeholders hosting their AI operations in nations with weak AI governance.[311] Binding rules for AI are particularly important for "high-risk application areas," such as those involving critical infrastructure.[312]

COMMUNICATION: As the multi-disciplinary literature on polycentric governance makes clear, opening up lines of communication is vital to

visited Sept. 7, 2020); *Statement on Algorithmic Transparency and Accountability*, ACM U.S. PUB. POL'Y COUNCIL (Jan. 12, 2017), https://www.acm.org/binaries/content/assets/public-policy/2017_usacm_statement_algorithms.pdf (last visited Sept. 7, 2020); *Fairness, Accountability, and Transparency in Machine Learning, Principles for Accountable Algorithms and a Social Impact Statement for Algorithms*, FAT/ML, https://www.fatml.org/resources/principles-for-accountable-algorithms (last visited Sept. 7, 2020); *Asilomar AI Principles*, FUTURE LIFE INST. (2017), https://futureoflife.org/ai-principles/?cn-reloaded=1 (last visited Sept. 7, 2020); *Ethically Aligned Design*, IEEE (Dec. 2017), https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/ead_v2.pdf (last visited Sept. 7, 2020); *OpenAI Charter*, OPENAI CHARTER (Apr. 9, 2018), https://openai.com/charter/ (last visited Sept. 7, 2020); *Tenets*, P'SHIP ON AI, https://www.partnershiponai.org/tenets/ (last visited Sept. 7, 2020); *Universal Guidelines for Artificial Intelligence*, PUB. VOICE (Oct. 23, 2018), https://thepublicvoice.org/ai-universal-guidelines/ (last visited Sept. 7, 2020).

307 *See* Urs Gasser & Virgilio A.F. Almeida, *A Layered Model for AI Governance*, 21 Inst. of Electrical and Electronics Engineers Internet Computing (November 2017), https://dash.harvard.edu/handle/1/34390353.

308 Ray, *supra* note 302.

309 Exec. Order No. 13,859, *supra* note 124.

310 EUR. COMM'N, *Code of Practice on Disinformation*, EUROPA (Sept. 26, 2018), https://ec.europa.eu/digital-single-market/en/news/code-practice-disinformation (laying out a code of conduct for social media companies to follow so as to limit the spread of disinformation; an approach that could be copied in the AI context).

311 Daly et al., *supra* note 163, at 26.

312 COMITER, *supra* note 98, at 81.

provide channels for interaction and coordination, discussed next.[313] Indeed, as Professor Ostrom has argued, there are "a large number of variables that increase the likelihood of cooperation in social dilemmas," including whether: "(1) reliable information is available about the immediate and long-term costs and benefits of actions;" (2) "the individuals . . . see the common resource as important for their own achievements and have a long-term time horizon;" (3) "gaining a reputation [as] a trustworthy reciprocator is important;" (4) communication with other individuals is commonplace, "(5) . . . monitoring and sanctioning is feasible" and (6) "social capital and leadership exist."[314] As such discussion of AI governance, even at a vague level, are vital first steps that can lay the groundwork for more substantive discussions around AI ethics and norms to follow.[315]

INTERACTION & COORDINATION: Fragmented regimes are likely across issue areas. It is unlikely, and likely ill advised, for expected successful polycentric regimes to arise across the myriad AI applications surveyed above.[316] As such, further research on cross-sector spillovers in the AI context is vital,[317] as is the case more broadly in cybersecurity and privacy. One such approach would be to leverage the ecology of games theory (EGT), which is "a theoretical tool for analyzing complex governance" that "attempts to function as a theoretical lens to improve the empirical analysis of polycentric governance systems."[318] In other words, EGT takes for granted that policy decisions in the real world are made across multiple informal and formal forums on varied geographic scales,[319] which is, in short, the story of AI governance summarized in Parts II–III. This framework—which has been applied to a variety of fields, including environmental policy, education, and economic development—is particularly useful for testing the functional utility of polycentric systems (thus not taking for granted the supposed benefits of such an approach), along with demonstrating the extent to which local fit is vital to success. In short, EGT offers a "theoretical platform for scholars to work toward this goal by exploring how the interconnectedness of

313 *See* Daniel H. Cole, *Advantages of a Polycentric Approach to Climate Change Policy*, 5 NATURE CLIMATE CHANGE 114, 115 (2015).

314 Ostrom, *supra* note 15, at 12.

315 *See* Daly et al., *supra* note 163, at 9, 12.

316 *See, e.g.*, Heikkila, *supra* note 236, at 208.

317 *Id.* at 210.

318 Ramiro Berardo & Mark Lubell, *The Ecology of Games as a Theory of Polycentricity: Recent Advances and Future Challenges*, 47 POL'Y STUD. J. 6, 6–7 (2019) (noting that, "the name itself builds on the metaphor offered by sociologist Norton Long (1958), who described urban systems as 'ecology of games' that consist of interlinked games (e.g., the banking game, the infrastructure game, the ecclesiastical game, etc.) played simultaneously by actors eager to achieve their individual goals.").

319 *Id.* at 7.

policy games and actors affects how much the latter learn about problems, collaborate with each other, and distribute the benefits and costs of their interactions."[320]

As applied to AI governance, EGT underscores the need to take a functional approach of the kind examined in Part III with particular emphasis on "cooperation, learning, and [the] fair distribution of gains."[321] Examples in this context would be incentivizing information sharing with regards to ethical AI best practices in a similar manner to the rise of Information Sharing and Analysis Centers (ISACs) in the cybersecurity context. Likewise, fair distribution evokes the need to consider the displacement impacts of AI technologies—as seen in the AV case study—and creates mechanisms such that the gains from this technology are shared across populations.[322] One version of such a system would be reminiscent of the International Seabed Authority in the Law of the Sea context, which is responsible for partnering with the private sector while sharing the benefits of mining deep seabed resources with developing nations.[323] An "AI Authority" could similarly partner with the public and private sectors to develop new AI applications while ensuring that some share of the realized benefits flow to displaced workers.[324] Of course, such collaboration is easier said than done. Given the security and economic stakes at issue, some commentators making predictions that "China will soon match or even overtake the United States in developing and deploying" AI,[325] fueling the "America First" approach to AI that is making international collaboration in this space more challenging.[326]

Together, such initiatives promote the layered approach to AI governance explored in Part III, ensuring that legal and ethical safeguards are respected through leveraging the technical architecture as part of a nested, polycentric structure. An AI Authority, for example, could be established to safeguard high-stakes critical infrastructure, with AI Codes of Practice being crystallized below that threshold to help ensure the protection of human rights, and to promote sustainable development. Such insights are ripe to ally to an array of additional case studies, such as healthcare and smart cities. Taking the first example, AI-enabled health technologies such as apps for health coaching highlight both the numer-

320 *Id.*

321 *Id.* at 13.

322 Kwang, *supra* note 295

323 *See* Jennifer Frakes, *The Common Heritage of Mankind Principle and the Deep Seabed, Outer Space, and Antarctica: Will Developed and Developing Nations Reach a Compromise?*, 21 WIS. INT'L L.J. 409, 416–17 (2003).

324 *See id.*

325 KAI-FU LEE, AI SUPER-POWERS CHINA, SILICON VALLEY, AND THE NEW WORLD ORDER 18 (2018).

326 Daly et al., *supra* note 163, at 25.

ous benefits possible for patients and providers, while also giving rise to concerns over "medical paternalism and privacy," along with cybersecurity.[327] Similarly, the rise of so-called "smart cities" underscore the degree to which trend lines are converging, bringing AI together with other trends, such as 5G, to create new opportunities for public safety and personal privacy risks.[328] These myriad applications share common concerns about AI governance. It would behoove the international community to address these concerns sooner, rather than later, lest dystopian futures become modern realities.[329]

The key ingredient, trust, provides the soil from which shared values and goals can grow. Polycentric governance provides a way to encourage the growth of these vital trust mechanisms, as introduced in Part I,[330] to serve as a facilitator between people with differing cultural backgrounds and technologies.[331] Shared values—such as a human-centered approach to considering AI ethics[332]—are vital to building trust frameworks, and to better address trending issues. As Elinor Ostrom maintained, "Trust is the most important resource."[333]

CONCLUSIONS

It has been said that the Internet makes possible "an unprecedented level of information-integration, providing the possibility to combine new and existing data and technologies (interoperability) and cope with growing resources and number of users (scalability) through the adoption of distributed systems (cloud computing)."[334] AI turbocharges opportunities within this integration and interoperability, making possible more efficient systems, opening up entirely new industries, and helping to both defend and threaten international peace and security.[335] But "[w]e are not

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327 David Arney et al., *A User-Focused Transdisciplinary Research Agenda for AI-Enabled Health Tech Governance* (Berkman Klein Ctr. for Internet and Soc'y at Harvard Univ., Paper No. 2019-1, 2019), https://ssrn.com/abstract=3385398.

328 *See, e.g.*, Nick Schifrin & Dan Sagalyn, *Chinese Tech Makes Cities 'Smart,' but Critics say it Spreads Authoritarianism*, PBS NEWS HOUR (Oct. 1, 2019, 6:35 PM), https://www.pbs.org/newshour/show/is-this-chinese-technology-a-trojan-horse-for-spreading-authoritarianism.

329 *See* JEFFREY KAPLAN, ARTIFICIAL INTELLIGENCE: WHAT EVERYONE NEEDS TO KNOW 146 (2016).

330 *See* John Ikenberry, *Trust: The Social Virtues and the Creation of Prosperity*, FOREIGN AFF. (Mar./Apr. 1996), https://www.foreignaffairs.com/reviews/capsule-review/1996-03-01/trust-social-virtues-and-creation-prosperity.

331 *See* Mariarosaria Taddeo, *Is Cybersecurity a Public Good?*, 29 MINDS & MACHINES 349, 352 (2019).

332 *See* Rahwan et al., *supra* note 38.

333 *Interview with Nobel Laureate Elinor Ostrom*, ESCOTET FOUND. (2010), http://escotet.org/2010/11/interview-with-nobel-laureate-elinor-ostrom/ (last visited June 29, 2018).

334 Zed Zulkafli et al., *User-Driven Design of Decision Support Systems for Polycentric Environmental Resources Management*, 88 ENVT'L MODELLING & SOFTWARE 58, 58 (2017).

335 KAI-FU LEE, *supra* note 325, at 22–30

passive spectators in the story of AI—we are the authors of it."[336] The international community has taken impressive steps in just the past few years to begin to address AI governance gaps, especially through the OECD, EU, and IEEE, among other forums.[337] These efforts may be conceptualized as part of a polycentric response to this global collective action challenge, and opportunity.[338]

It is time to apply "Ostrom's Law"—that "[i]nstitutional arrangements 'that work in practice can work in theory' "[339]—to reconceptualize AI governance. But for the fruits of these diverse efforts to be realized—and so as not to fall in the fragmentation trap—the following lessons of successful polycentric systems must be learned: (1) including the need for nested decision-making centers, (2) baseline norms, (3) promoting accountability and conflict resolution; (4) deepening communication channels; and (5) encouraging interaction and coordination across stakeholders.[340] By learning these lessons, an AI arms race may be avoided, and a new frontier of human knowledge and productivity could be peacefully unlocked. It is our choice, a human choice, and among the most important we are likely to collectively make. Let us rise to the occasion.

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336 KAI-FU LEE , *supra* note 325, at 230.

337 Daly et al., *supra* note 163, at 9.

338 Ramiro Berardo & Mark Lubell, *supra* note 318, at 8.

339 Dalibor Rohac, *Indiana's Gift to the International Order*, AM. INTEREST (May 10, 2018), https://www.the-american-interest.com/2018/05/10/indianas-gift-to-the-international-order/.

340 *See* Elinor Ostrom, *Polycentric Systems: Multilevel Governance Involving a Diversity of Organizations*, *in* GLOBAL ENVIRONMENTAL COMMONS: ANALYTICAL AND POLITICAL CHALLENGES INVOLVING A DIVERSITY OF ORGANIZATIONS 105, 118 tbl. 5.3 (Eric Brousseau et al. eds., 2012).