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For Open Publication

Dec 11, 2024

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

25-T-0284

Seizing the Moral High Ground: Accelerating a Values-based Global AI Agenda

FINAL REPORT

May 2021

The Dwight D. Eisenhower School for National Security
and Resource Strategy
National Defense University
Fort McNair, Washington, D.C. 20319-5062



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Executive Summary

Artificial Intelligence, or AI, is **not a single, stand-alone industry** but a broad set of applications fueling life-altering technologies like autonomous driving, remote surgery, and autonomous weapons systems. AI is “the theory and application of machines...to perform tasks that typically require human intelligence.” AI’s strategic implications for global peace, stability, and prosperity have prompted prominent analysts to label it “**the most powerful tool in generations.**” The United States has a great interest in maintaining its innovative edge in the development and deployment of AI.

Much like transformative technologies of the past, AI has the potential to richly benefit or decidedly harm humanity. AI does not have values, but **its applications indisputably mirror the values of those that develop and deploy them**, and two divergent models have emerged. In an **authoritarian model** purveyed by China, citizens possess little control over the collection and use of their personal data, states regularly surveil citizens’ movements and finances, militaries produce unregulated AI-powered autonomous weapons systems, and AI expands the reach of global disinformation. The United States and liberal allies strive for a dramatically different **application of AI that respects the rule of law, human rights, and democratic values**. *To best leverage the profoundly transformative effects of AI and emerging technologies, deter common threats, create prosperity, ensure our innovative edge, and promote democratic liberal values, the United States, in concert with like-minded countries and global industry, must catalyze efforts to deploy values-based AI standards and strengthen multi-stakeholder collaboration to accelerate innovation.*

This paper proposes the following values-based policy recommendations, focused on increasing multilateral engagements and partnerships, and bolstering our domestic innovation base:

I. **Challenge:** While some governments have agreed to AI principles and standards, more cohesion, buy-in, and implementation is needed by a multi-stakeholder coalition.

Recommendation: Accelerate efforts to establish a “Digital Coalition” of democratic states and the private sector to coordinate efforts on AI and other emerging technologies with broad participation.

II. Challenge: Lack of binding international standards on military applications of AI increases risk of rapid escalation to conflict.

Recommendation: Draft and seek formal United Nations' adoption of binding international treaties on the development and deployment of military applications of AI.

III. Challenge: Lack of global consensus regarding the rules for the collection, storage, and transfer of data across borders risks fractured and inefficient digital markets, which harm critical U.S. industries and infringe on individual rights.

Recommendation: Prioritize new digital trade agreements to promote U.S. commitment to values-based leadership in concepts of flow of data with trust.

IV. Challenge: The United States lacks a comprehensive regulatory framework for the ethical application of AI technology, and principles are largely shaped by private companies.

Recommendation: Ensure a values-based regulatory framework for the use of AI-related technologies.

V. Challenge: Federally funded basic and exploratory R&D levels are not sufficient to maintain our innovative edge.

Recommendation: Fund and incentivize investment in AI-related R&D.

VI. Challenge: The United States is vulnerable to supply chain disruptions and shortages in AI-related hardware.

Recommendation: Deploy a coherent industrial strategy as part of the President's American Jobs Plan, including prioritized manufacturing needs of the future U.S. economy and incentivizes private investment in cutting edge hardware and software solutions for AI.

VII. Challenge: The United States' human-capital base is not prepared or sufficiently empowered to meet the demands of a digital economy.

Recommendation: Strengthen, fund, and incentivize STEM education at all school levels and retraining initiatives.

Introduction and Strategic Environment

Artificial Intelligence, or AI, is indelibly shifting and rewriting the world’s political, social, and economic structures. Just as the invention of **electricity** radically altered businesses, spurred an era of unprecedented productivity, and enabled humans to interact in previously unthinkable ways, AI is at the heart of a wave of transformative technologies like autonomous driving, remote surgery, and autonomous weapons systems that are fundamentally altering the way we live.¹ In these, and countless other areas of life, AI machines are synthesizing, analyzing, and contextualizing vast quantities of data. Advanced telecommunications technologies are enabling data transfers at unprecedented speeds with negligible latency, thus accelerating decision making and **automating and augmenting capabilities previously reserved for humans.**

Given these broad applications and impacts, it is essential to understand that **AI is not a single, stand-alone technology or industry.** Rather, the National Security Commission on Artificial Intelligence (NSCAI), an independent commission of high-level experts exploring AI’s unprecedented impacts on national security,² has deemed AI “a field of fields ... (that) holds the secrets which will reorganize the life of the world,” and “the most powerful tool in generations.”³ It is the common denominator driving the “Fourth Industrial Revolution”^a (Industry 4.0), blurring boundaries between the physical, digital, and biological worlds, with unlimited strategic implications for global peace, stability, and prosperity.⁴

New and potential applications of AI are propelling the **Fourth Industrial Revolution** at full tilt, engendering excitement about societal benefits and equally strong fear of unknowable consequences and abuses. This juxtaposition of views is at the heart of AI’s potential to redefine global power and illustrates perhaps the only remaining distinction between human and machine intelligence: **values.** Simply put, AI technologies do not have values, but the applications of technologies indisputably mirror the values of those that develop and deploy them. **Securely and ethically** harnessing the advantages of AI in the Fourth Industrial Revolution has the

^a World Economic Forum President Klaus Schwab first introduced the “Fourth Industrial Revolution” at in 2016, and the term has gained wide traction since then.

potential to bestow powerful **competitive advantage** to companies and countries that demonstrate they will responsibly handle the personal information of consumers and citizens.⁵

However, **not all stakeholders share common values** about the proper development and application of AI technologies, a sentiment at the heart of President Biden’s characterization of the Fourth Industrial Revolution as “a battle between the utility of democracies in the 21st century and autocracies.”⁶ The United States and China, the two nations that stand to gain the most economically over the next decades from the development and deployment of AI, are its main players for now.⁷ As first movers in AI technology development and deployment, they are each playing a decisive role in framing the value system.

On one hand, in the United States, there are robust and ongoing debates over constitutional limits on the use of **data, facial recognition technology, and content moderation** by “big tech” companies and the government. The White House elevated AI policy as a matter of national security in its Office of Science and Technology Policy (OSTP), issuing strategic guidance in numerous AI-related areas, including research and development, education, and manufacturing. The world’s most advanced economies established a set of **common and comprehensive AI principles** at the Organization for Economic Cooperation and Development (OECD) **based on liberal democratic values** and are advancing these principles through the Global Partnership on AI (GPAI), an initiative whose membership expands well beyond that of the OECD. And the European Union (EU) introduced the world’s first comprehensive regulatory frameworks to govern both data and AI technologies.

On the other hand, in many parts of the world, governments embrace a more **authoritarian application of AI**. While Chinese President Xi mandated in 2018 that China “develop, control and use artificial intelligence to secure the country’s future in the next technological and industrial revolution,” Russian president Vladimir Putin has warned that “...the one who becomes the leader in this sphere [AI] will be the ruler of the world.”⁸ Both countries embrace strong state involvement in research and development, while proselytizing and exporting authoritarian applications across the globe. In these models, citizens possess little control over

the collection and use of their personal data, states regularly surveil citizens' movements and finances, militaries produce unregulated AI-powered autonomous weapons systems, and AI expands the sophistication and reach of global disinformation campaigns. Unlike areas like climate change, international health, or counter narcotics, **very little room for cooperation** exists with authoritarian regimes on the development and deployment of AI applications; **the gap in our value systems is simply too wide to bridge.**

Sovereign governments, multilateral organizations, private sector AI developers, and rights activists all recognize the fundamental role of values in regulating AI, and are deeply invested in establishing norms, principles, and standards. The dramatic rise in digital trade and global information sharing limits the ability of sovereign states to **solve today's challenges alone.** Therefore, international cooperation between governments, global firms, and academic institutions is increasing in importance. Cross-border collaboration on responsible global development of AI can be the connective tissue between like-minded nations on principles that reinforce transparency, safety, security, and accountability.⁹ Governments and global industry leaders can build trust and consensus in a collection of technical standards that enable high-quality AI development in areas such as security, spectrum management, and open architectures. Most importantly, by occupying a seat at the table within international standard setting organizations and finding **common ground with partners, industry leaders can assert pressure against authoritarian** attempts to unduly influence the process to create standards that unfairly favor authoritarian ends. *To best leverage the profoundly transformative effects of AI and emerging technologies, deter common threats, create prosperity, ensure our innovative edge, and promote democratic liberal values, the United States, in concert with like-minded countries and global industry, must catalyze efforts to deploy values-based AI standards and strengthen multi-stakeholder collaboration to accelerate innovation.*

Description of Artificial Intelligence

In the absence of a common definition of AI, this study adheres to that of the Harvard's Belfer Center of Science and International Affairs: "the theory and application of machines—especially

computer programs—to perform tasks that typically require human intelligence, such as image labeling and generation, speech recognition and synthesis, natural language understanding and production, as well as various other perception-action based engagements.”¹⁰ Artificial intelligence, machine learning, and deep learning are all part of an evolution of computer and data driven advances in decision making and automation (figure 1).¹¹

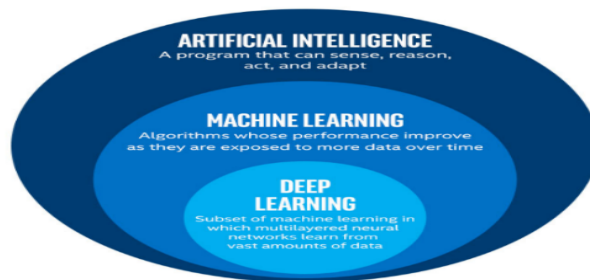


FIGURE 1: WHAT IS AI?

Global businesses and governments are deploying AI, collecting and utilizing troves of data, augmenting human capabilities and automating systems to accelerate decisions everywhere. The average American now encounters AI technologies multiple times a day, whether through Internet of Things-enabled devices,^b financial technology, biometric identification, e-government applications, social media, online shopping, or media streaming. It is possible to analyze U.S. artificial intelligence industries and stakeholders through a modified Porter’s Diamond framework of international competitiveness (figure 2).¹² A 2018 study found AI-driven technologies will increase global GDP by \$15.7 trillion by 2030. China and North America will see the greatest gains, driven by increased productivity and consumer demand (figure 3).¹³

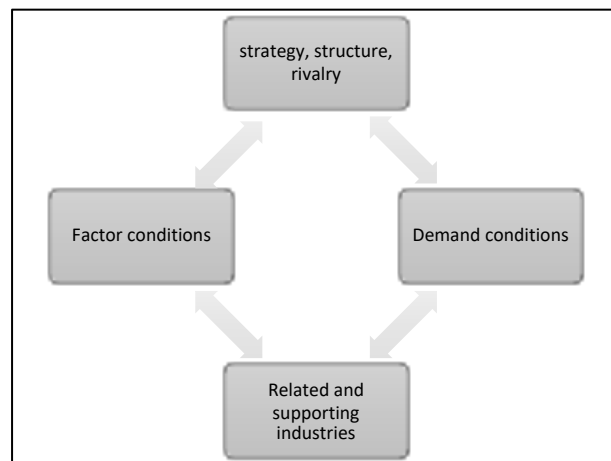


FIGURE 2: PORTER'S DIAMOND

^b Internet of Things refers to physical objects that utilize data to connect and exchange data and information with one another over the internet. Examples include consumer electronics and appliances, medical devices, and vehicle computers. Though such devices are already in wide use, the advent of fifth generation telecommunications technology (“5G”) is projected to enable artificial intelligence to superpower the spread and use of such devices.

FIGURE 3: PROJECTED GLOBAL AI GAINS¹⁴

Strategy, Structure, and Rivalry

- AI is Changing the Nature of Value Creation: Robust cooperation between government funding, private industry, and academia underpins the U.S. innovation system. Intense competition and a prevailing commitment to open-source sharing in private industry and academia fuels innovation.
- AI is a National Security Issue:
 - AI advancements have pushed national security concerns well beyond weapons, conventional systems, and tools of war.
 - Public spending on research and development (R&D) has declined substantially as a portion of GDP since the end of the Cold War. This paper explores this, along with existing R&D collaborations between government, academia, and industry, and opportunities to improve innovation through R&D funding.
- AI Rivalries Cross Borders:
 - The international diffusion of AI knowledge throughout the globe, including strong interaction between researchers and experts across borders, is reshaping the U.S. competitive edge.

- **Rivalries between big tech giants and sovereign governments** over ethical approaches to privacy, content moderation, and research standards are fueling competition.

Demand Conditions:

- Establishing **trust** between machines and humans drives demand for AI. The balance between preventing market failure and stifling innovation is delicate.
- AI algorithms demand **massive quantities of data** to produce effective results. China's controlled market structure and sheer size provides a "treasure trove" of data that fuels its AI applications, including nearly ubiquitous use of data-producing applications for services like mobile money and food service delivery. Access to data is China's competitive advantage compared to the United States, Europe, and like-minded countries that are creating algorithms with smaller, more restricted data sets.¹⁵
- In liberal democracies, **data is largely collected, managed, and stored by private companies, while** governments face limits in collection and use of citizen data. Minimal federal guidelines provide private companies wide latitude to set data use standards by default.

Related and Supporting Industries:

Numerous industries support the emergence of robust AI systems and networks:

- **Fifth generation (5G) telecommunications infrastructure** (and 6G and beyond) provide a backbone for integrated AI and machine learning technologies, will support the rise of edge computing, and will carve new paths in collaborative and autonomous decision making.
- However, a lack of end-to-end suppliers of 5G telecommunications equipment in the United States and offshoring of most ICT manufacturing, combined with trust concerns about Chinese-made equipment, has created U.S. reliance on hardware providers from Finland, Sweden, and South Korea (ROK). Advances in **Open RAN** and wireless network projects

from DARPA promise to improve network security, prepare the network for the IoT, and reduce dependence on this small pool of network hardware providers.^c

- **Semiconductors** (or integrated circuits or computer chips) are the core components of powerful computing technologies. Intel founder Gordon Moore in 1965 accurately predicted the number of transistors on microchips would double every two years. As AI has gained traction, modern tech leaders like NVIDIA Chairman Jensen Huang now assert hardware, software, and AI synergies are accelerating the pace of chip improvements. The semiconductor industry is complex, highly competitive, and faces critical supply chain shortages and policy-maker attention. Taiwan Semiconductor Manufacturing Company (TSMC) – a global leader in semi-conductor innovation – exemplifies strong international collaboration to push the physical limits of this technology.^d Though China lags Taiwan and the United States in chipmaking capability, its investments in this space demonstrate the importance of this technology to national AI competitiveness.

Factor Conditions:

- AI is multidisciplinary, with ethics at its core: Leading Carnegie Mellon University (CMU) computer scientists Andrew Moore and Martial Hebert developed the original “AI Stack” (figure 4)¹⁶ to describe the multidisciplinary nature of AI.
- Each of eight blocks represents a separate area of research, development, and deployment, from hardware intensive devices and computation to the remaining seven software intensive elements. Data collection and analysis methodology shape the success of any machine-driven modeling, decision support, planning, and action. The inclusion of ethics

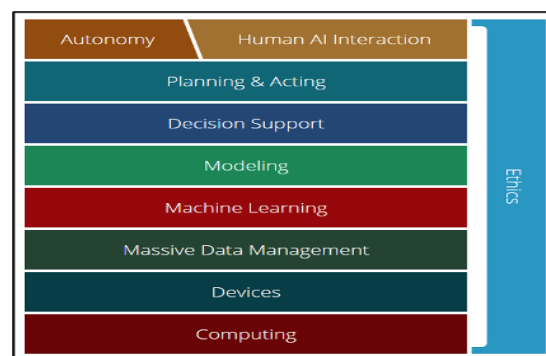


FIGURE 4: THE AI STACK (MOORE AND HERBERT)

^c Open RAN, or open radio access networks, will utilize cellular radio network hardware and software components to operate in a truly open and interoperable way through multiple vendors. Private companies and DARPA are working Open RAN capabilities.

^d Working with Massachusetts Institute of Technology (MIT) and National Taiwan University (NTU) researchers, TSMC announced in May 2021 1nm chips are within reach. This is the latest in a line of TSMC-led breakthroughs. Pan, Che, Celia Chen. “U.S.-China Tech War: TSMC Helps Make Breakthrough in Semiconductor Materials that Could Push Back the “end” of Moore’s Law.” *South China Morning Post*, May 19, 2021.

as a universal consideration signals the fundamental importance of values as governments grapple with their role in AI.

- Regulations and policies on data collection, storage, and use are the subject of debate and action from local government to multilateral international organizations and are the basis for government-to-government cooperation and disputes over trade, intellectual property, and tax burdens. Annex A contains a list of U.S. executive orders, federal-level strategy documents, proposed legislation, and regulations on AI and related technologies. (The list does not include state and local regulatory and policy frameworks.) The United States federal government lacks values-based guidelines and regulations pertaining to privacy, algorithmic fairness, and R&D funding, which this paper explores.

Values Based Leadership: A Building Block of AI Engagement

The 2021 Interim National Security Guidance integrates U.S. foreign policy objectives with economic and social benefits for its own citizens, while building U.S. credibility and capacity abroad.¹⁷ AI technologies, which know few international boundaries in their limitless potential both to improve or to damage the world, play a central role in this values-based national security policy. Just as the United States is grappling with important policy and regulatory challenges that can keep pace with the advent of AI technologies, so too are most governments around the world.

Two compelling arguments favor **values-based coalition building**. First, multiple governments utilize AI technologies and data to surveil citizens, intimidate companies and individuals, and repress public information. Most prominent among these is the Chinese Communist Party (CCP), which is driving aggressively to become the world's leading AI innovator through its 2017 New Generation Artificial Intelligence Development Plan (AIDP) and *Made in China 2025*. While the AIDP rhetorically promises to create leading ethical standards, China's AI-powered surveillance, data localization, and weapons development contradict this promise. CCP actions indicate strong prioritization of AI as a tool of security and commercial interests, not values,¹⁸ and the CCP's

unfettered and unregulated access to all citizen data proves AI’s potential as a “powerful tool for autocratic control.” Political scientist Graham Allison, calls “China’s embrace of AI represents a marriage made in hell.”¹⁹ China is working to export Chinese telecommunications infrastructure and hardware globally, along with data policies that allow absolute government control over collection and storage of personal information.

Second, the EU proposed the world’s first comprehensive AI regulations to safeguard rights and equality in April 2021. However, the United States and other advanced economies have achieved limited consensus on values-based AI principles through multilateral bodies. All 36 member of the OECD and several aspiring members drafted and signed the values-based OECD AI Principles in 2019.²⁰ These principles assert “AI systems should be designed in a way that respects the rule of law, human rights, democratic values and diversity, and they should include appropriate safeguards – for example, enabling human intervention where necessary – to ensure a fair and just society.”²¹ The G20 built on these OECD principles in its own non-binding AI agreement, which promotes principles of “inclusive growth, sustainable development and well-being; human-centered values and fairness; transparency and explainability; robustness, security, and safety; and accountability,” along with policy guidelines for international cooperation, capacity building, and research and investment.²²

The following examples and theoretical descriptions are framed within the five OECD Principles as a reflection of values-based approaches to build trust in AI and related technologies.

Human-Centred Values and Fairness: *AI systems should be designed in a way that respect the rule of law, human rights, democratic values, and diversity, and they should include appropriate safeguards – for example, enabling human intervention where necessary – to ensure a fair and just society.*²³

- Citizen “**social scoring**,” which can measure the financial and social behavior of individuals and corporations using AI-enabled surveillance systems, exemplifies illiberal use of AI. EU regulations propose a ban on social scoring, but the United States lacks guidelines to define criteria to inform participants on the use of their data.²⁴ By contrast, China applied its social credit scoring system to all citizens in 2020 without their consent, aggregating 537 variables

across 400 central and local government data sets to judge citizens' trustworthiness.²⁵ While AI-enabled "scoring" does have practical applications such as school systems and assessing driver's license points, its use risks violating civil liberties without careful regulation and transparency of methodology.

- **AI-driven facial recognition** technologies offer powerful law enforcement and security benefits. They are also subject to abuse, and are closely linked to the rise in manipulative and persuasive 'deepfake' or 'digital imposter' imagery that can erode societal trust. Governments in nearly 100 countries, including the United States, utilize facial recognition, and only three national governments outright ban it. However, the lack of widespread regulation governing its use is the subject of intense debate in many countries.²⁶ China employs facial recognition as part of a broader policy of tight state control and police surveillance. This includes close monitoring of marginalized ethnic groups,²⁷ and police officers regularly run rapid facial ID analysis to label 'possible threats.'²⁸ China is also facilitating the use of facial recognition by autocratic regimes, helping countries use Huawei technology to monitor opposition and crush dissent.²⁹

Transparency and Explainability: *There should be transparency and responsible disclosure around AI systems to ensure that people understand AI-based outcomes and can challenge them.*³⁰

- **Traceability** is a critical component of establishing trust in AI systems, providing transparency on how data is gathered, sorted, and labeled, and making available the algorithmic basis for outcomes.
- AI systems that **clearly identify themselves as such** provide dignity to users and reinforce better decision making.³¹

Robustness, Security and Safety: *AI systems must function in a robust, secure and safe way throughout their life cycles and potential risks should be continually assessed and managed.*³²

- Safeguards to eliminate **algorithmic bias**, especially as it applies to gender, racial and age discrimination, can only be as good as the finite amount of data in any given AI system. Examples abound of algorithmic bias in candidate screening for hiring³³ and erroneous

targeting of criminal suspects often of minorities. A substantial body of academic and policy work offering best practices to reduce algorithmic bias is growing.³⁴

- **Privacy and data protection** is a touchpoint for citizens concerned about the increasing trend of personal data exposures. The United States lacks national level privacy regulations, while the EU is at the forefront of data protocols on digital security, data collection, storage and transfer, and access.³⁵ The Chinese government stifles societal debate over privacy in the name of national security.
- Industry leaders should expect continuous debate over **safety in autonomous vehicles** to build consumer trust (and demand) and assuage fear. A fatal Tesla Model S crash in 2021 exemplifies this safety debate: While the vehicle was on autopilot at the time of the accident, the National Transportation Safety Board and Tesla faulted the passengers.³⁶

Accountability: *Organizations and individuals developing, deploying, or operating AI systems should be held accountable for their proper functioning in line with the above principles.*³⁷

- Health care, education, and criminal justice are just three areas in which developers must be able to explain the reasoning behind AI decisions.

Inclusive Growth, Sustainable Development and Well-Being: *AI should benefit people and the planet by driving inclusive growth, sustainable development, and well-being.*³⁸

- Sovereign governments are grappling to ensure increasing automation does not leave workers behind. Up to a quarter of U.S. jobs will face “high exposure” to **automation** over the next decade, and AI technologies could replace 70 percent of the tasks associated with the current U.S. job market,³⁹ while creating new jobs requiring more sophisticated skill sets. India, which seeks to become a technology manufacturing hub, is exploring AI skills programs but faces quality and access challenges.⁴⁰
- AI may be useful to measure environmental change and air pollution, but the **environmental impact** of high-powered computations is skyrocketing, with data centers devouring an estimated 3 percent of all electricity on the planet this year.

Competing Values Framework: The Competing Values Framework (CVF), a model for understanding organizations' behaviors and beliefs, is a useful tool to illustrate both the overlap and gaps in values related to the use of AI among leaders in the sector. Using OECD AI Principles as a baseline, the below graph analyzes AI value sets in the United States, EU, China, and India. Regulatory and policy structures in the United States and EU reflect an **emphasis on values of equality, transparency, fairness, and explainability**. China places much more value on AI as a means for **economic growth and public and health services**, while deemphasizing accountability, transparency, fairness, and public trust. India's hybrid approach to transparency and equality, and transparency in regulation, policy, and societal discourse reflects a less advanced AI market compared to the others as well as its emerging economy perspective.

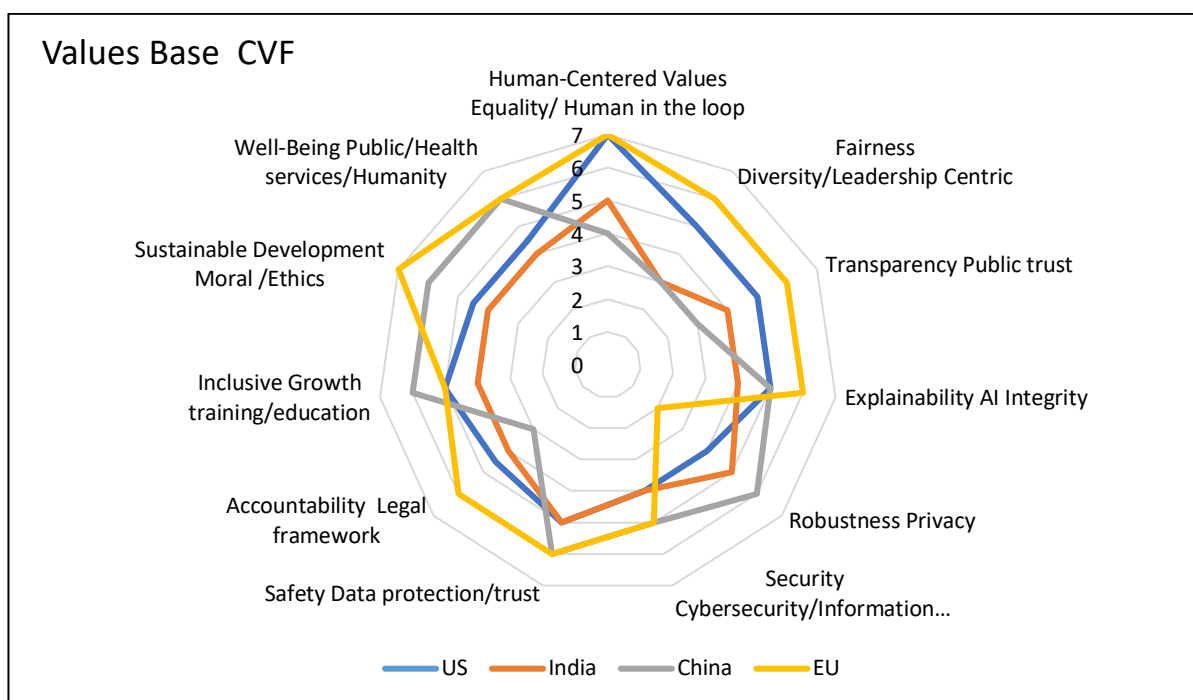


FIGURE 5: CVF FRAMEWORK

Forging a Values-Based Domestic Innovation System

The United States can sustain its competitive advantage in AI by cultivating a resilient innovation ecosystem based on two pillars: **values-based leadership** and a more **robust domestic innovation base**. While many AI industry leaders are exploring frameworks for the ethical application of technologies, it is the government's duty to craft and enforce regulations

that engender public trust. In a recent domestic poll, nearly half of respondents said AI would reduce personal privacy, and a third believed robots and AI represented a threat to humanity.⁴¹ If the United States intends to lead international partners in catalyzing the use of values-based AI standards globally, its regulatory architecture must enshrine these values. Leading AI from a position of strength requires a robust domestic innovation base with adequately resourced public-private R&D, an AI-ready workforce, and a capable domestic manufacturing base.

Working Toward a Values-Based U.S. Regulatory Framework

Multiple federal strategy documents focus on America's competitive edge in AI (see Annex A), but U.S. regulations have not kept pace with AI deployment in areas such as data privacy, content moderation, and facial recognition.

Data Privacy: The proper use of citizen's data is a contentious area ripe for regulation. The EU's Global Data Protection Regulation (GDPR) of 2018 and subsequent Digital Services Act Package (DSA) of 2020 guarantee individual privacy rights through enhanced trust in the storage, use, and transfer of data.⁴² A potential model for federal regulation in the United States, 83 non-EU countries and California already modeled regulations and standards on GDPR.⁴³ The EU already enforces these strict legal protections through stiff penalties against the world's leading "big tech" corporations, drawing on the provisions allowing extraterritorial prosecution of any entity collecting data on European citizens. These multinational corporations, largely based in the United States, spent billions of dollars arguing GDPR and DSA are *de facto* tariffs that stifle competition and deter investment.⁴⁴ After facing sizeable fines, the largest corporations have moved to adopt these policies rather than divesting, thus institutionalizing more transparent and responsible use of data. Separately, the United States and Japan promoted the concept of "free flow of data with trust," through the Japan-led Osaka Track concept of the G-20 in 2020,⁴⁵ and the U.S. led APEC Cross Border Privacy Rules (CBPR) of 2011.⁴⁶

Content moderation, which relies on user data, is also largely unregulated and subject to the terms of use of individual companies. Facebook CEO Mark Zuckerberg postulated before Congress that "the real question, as the internet becomes more important in people's lives, is

what is the right regulation, not whether there should be or not.”⁴⁷ Now under attack for data privacy abuses, disinformation propagation, and election meddling, Facebook implemented its business model in a vacuum of government direction.

Facial Recognition: AI-enabled facial recognition offers a host of practical applications, from unlocking iPhones to flight check-in and law enforcement. However, facial recognition applications suffer from well-documented algorithmic biases in gender and race. Numerous U.S. cities, including San Francisco, Boston, and Portland ban facial recognition applications in law enforcement.⁴⁸ Amnesty International is leading the charge to curb government use of facial recognition via its “Ban the Scan” campaign.⁴⁹ Additionally, leading technology companies are reconsidering their involvement in this sector.

Strengthening Our Domestic Innovation Base

America’s robust domestic innovation base has long relied on federal R&D funding, a ready workforce, and a capable domestic manufacturing base. China’s aggressive efforts to dominate in AI is shifting U.S. competitiveness.

Increasing Federal R&D Spending and Resources

Numerous analysts assess federally funded basic and applied exploratory research and development, particularly across the constellation of AI and emerging technologies that will define the industries of the future, is insufficient to sustain America’s innovation competitive edge. **Why does publicly funded basic and exploratory R&D matter?** As opposed to privately funded R&D, which is more risk-averse in its focus on short-term gains and profits, publicly funded basic and exploratory R&D allows for more experimentation. Federal investment in basic R&D has led to the development of important technologies such as global positioning service (GPS), supercomputing, the internet, cellular communications, and core technologies used in smartphones.⁵⁰

Federal appropriations for R&D are currently stagnant and far below the level necessary to lead the world from a position of technological advantage in strategic competition.^{51/52} Over a

twenty-year timeframe, China increased its global share of public and private R&D from under five percent in 2000 to more than 26 percent, while the U.S. share of global R&D has fallen below 28 percent.⁵³ By underinvesting, the United States has retreated from the technology high ground and given momentum to its strategic rival.

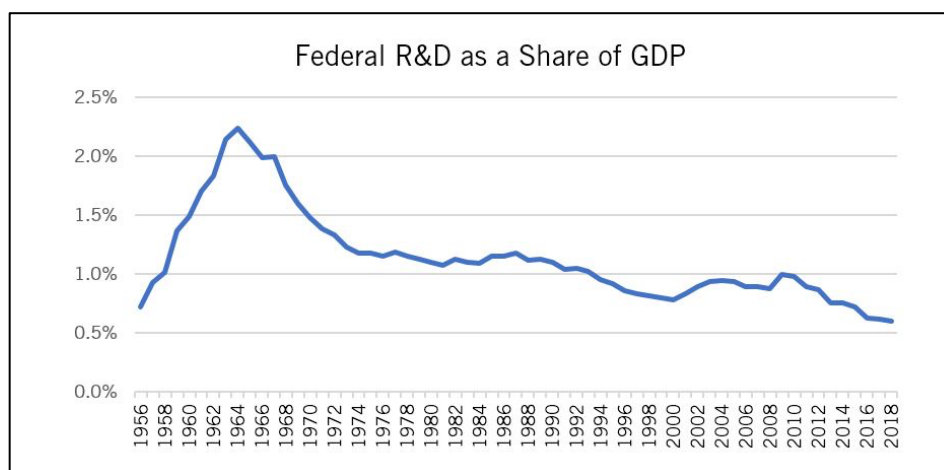


FIGURE 6 : U.S. FEDERAL R&D PER GDP 1956-2018 ⁵⁴

The scale of R&D expenditures by leading AI-intensive firms in the United States gives an indication of the level of required investment to create value. In 2018, Alphabet, IBM, Facebook, Microsoft, and Amazon invested over \$80 billion in R&D.⁵⁵ The 13-to-1 disparity between annual private and public investments in AI is disquieting because the progress of emerging technologies from foundational discoveries to profitable concepts and products typically takes decades, not years.

Federal AI funding increases in recent years are inadequate. In fiscal year (FY) 2020, the combined defense and nondefense discretionary AI R&D budget was approximately \$5 billion.⁵⁶ The FY2021 omnibus appropriations bill expanded the budget for AI R&D to \$6 billion, a 20 percent increase.⁵⁷ The President’s blueprint for FY 2022 discretionary funding proposes “historical increases in funding for foundational research and development.”⁵⁸ However, one prominent think-tank assessed that 97 percent of the \$130 billion increase in discretionary spending is not aligned to programs that will improve technology competitiveness against China.⁵⁹ It does, however, propose expanded funding for the National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST), some of which will support AI

R&D. Absent details, it appears the \$40 billion pathway to scale and sustain AI R&D as recommended by the NSCAI will fall well-short of the “down payment” needed to achieve the near-term future of AI breakthroughs.⁶⁰

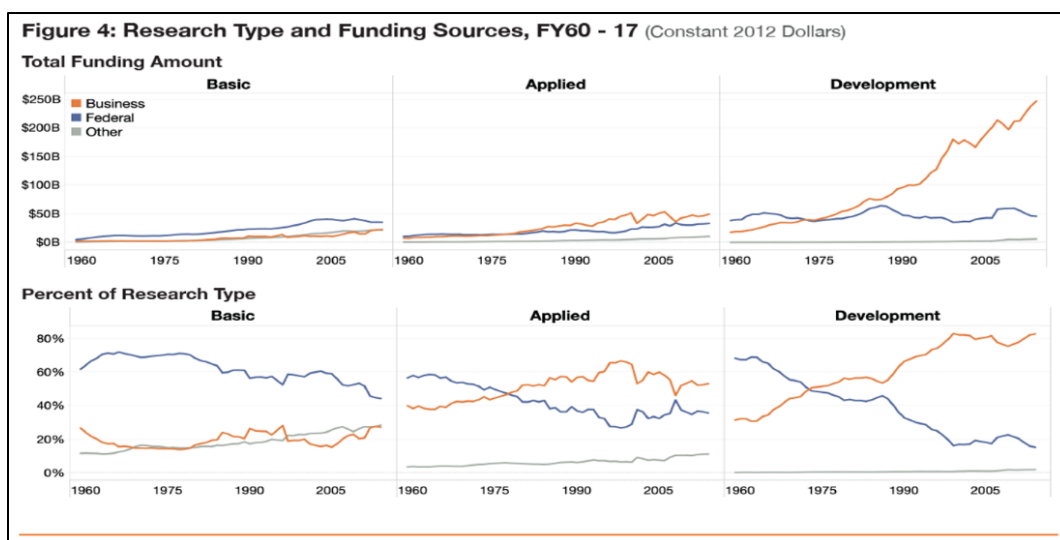


FIGURE 7: BASIC, APPLIED, AND DEVELOPMENT R&D IN THE U.S., 1960-2017⁶¹

National laboratories, where much of federally funded R&D takes place, lack resources to conduct essential cutting-edge research for AI advancements. To address shortfalls, Pacific Northwest National Lab recently partnered with Verizon to install 5G telecommunications equipment and launched a “5G Innovation Studio,” enabling researchers to perform research in areas like human-machine teaming and IOT.⁶² The Biden Administration’s Build Back Better plan aims to support telecommunications infrastructure modernization, with 5G-enabled broadband or wireless broadband for every American. While closing the digital divide between urban and rural America, the plan seeks to establish R&D across a wider swath of public and private research facilities.⁶³ Enhancing access to 5G across the national labs system, DOD research facilities, and into major research universities could empower research efforts and bolster America’s innovative edge.

Ensuring an AI Ready Workforce

The U.S. innovation system relies on human capital, including an AI-ready workforce to lead and compete in a digital economy. Four critical elements to achieve this objective include:

improving STEM education at the K-12 level, fostering policies that tap into the talents of our diverse population, implementing immigration reform that allows us to attract the world's top talent, and creating a system to retrain and support those displaced by AI and automation.

Improve STEM Education: Basic K-12 STEM education in the United States is in urgent need of improvement. Per the NSF, our 8th graders rank in the middle of advanced economies in mathematics and science testing; scores have not improved over the last decade.⁶⁴ As *Freedom's Forge* author Arthur Herman noted, the United States is in a **STEM education "crisis,"** especially given our growing reliance on STEM fields for areas of critical national security.⁶⁵ The United States should look to enhance the quality and quantity of STEM education at the primary and secondary levels, ultimately leading to a greater number of entrants in STEM-related careers. The 2010 White House-led public-private partnership, "100k in 10" expects to exceed its goal of recruiting and training 100,000 new STEM teachers by the end of 2021.⁶⁶

Diversity in STEM: The Interim NSS highlights diversity as a competitive advantage for the United States, but 84 percent of American STEM professionals are white or Asian males.⁶⁷ Women receive less than a fifth of computer science and engineering degrees and hold only 28 percent of STEM jobs. Just 2.7 percent of African Americans and 2.2 percent of Latinos have earned a university degree in natural sciences or engineering by age 24.⁶⁸ Encouraging diversity in STEM is not just a feel-good policy. A study found mixed-sex teams file 40 percent more patents than all-male teams, illustrating how diverse thinking improves outcomes.⁶⁹ Although Historically Black Colleges and Universities (HBCUs) make up only 2.0 percent of U.S. higher education institutions, they produce the majority of Black students in STEM. The NSF found in 2013 that 21 of the top 50 baccalaureate-origin institutions of black science and engineering PhD recipients are HBCUs.⁷⁰ The University of Baltimore County is implementing a successful four-pillar approach to account for systemic bias that deters Black and Latino STEM students from matriculating.⁷¹

Importance of Immigration: Entrepreneurial immigrants are a long-standing pillar of the U.S. innovation ecosystem, from Nikola Tesla to Elon Musk. A study showed that immigrants or children of immigrants founded 44 percent of U.S. Fortune 500 companies.⁷² While the United

States is still a top destination for international students and entrepreneurs, **recent immigration policy changes have impeded recruitment of talented innovators** from abroad.⁷³ The proposed SECURE CAMPUS Act of 2021, which restricts Chinese students from certain undergraduate and graduate degree programs to diminish intellectual property theft, is broad and risks draining an important component of the U.S. STEM talent pool. Canada’s immigration system attracts and retains foreign talent by processing skilled worker permit applications in two weeks or less; by contrast, the U.S. H-1B skilled workers status can take more than six months. Canada also offers incentives to attract AI talent such as scholarships and business support services.

Reskill, Retrain, and Improve the Social Safety Net: The United States lacks a workforce **reskilling plan** to meet the challenges of an AI-driven economy. AI and related technologies could displace 85 million jobs worldwide by 2025,⁷⁴ while a quarter of U.S. jobs face automation, and AI could replace more than 70 percent of work tasks over the next decade.⁷⁵ Internationally, the World Economic Forum launched the public-private "Reskilling Revolution" in 2020, which aims to improve education, skills, and jobs for one billion people by 2030.⁷⁶ The United States offers a weak social safety net to workers displaced by AI.⁷⁷ Community colleges could expand non-degree credential programs for specific skills, while coding boot camps could provide practical alternatives to four-year degrees for many.⁷⁸ There is growing support for government-funded post-high school tuition support for up to two years.⁷⁹

Advanced Domestic Manufacturing: The U.S. manufacturing model, including for high-tech hardware, is built on complex global supply chains that minimize production costs. By contrast, Shenzhen, China – known to the manufacturing world as the “Silicon Valley of Hardware”—exemplifies China’s growing dominance over global technology supply chains. Once a cheap electronics manufacturing center, direct Chinese government support has transformed Shenzhen into an “unmatched ready-made manufacturing ecosystem” with comprehensive “supply chain and logistics infrastructure, manufacturing experience and knowledge, and engineering talent and range.”⁸⁰ The city now attracts hardware startups from around the world, who use it as base “from idea to product to scale to shipment at speed.”⁸¹

The global pandemic and multiple costly cyberattacks of 2020 magnified China's growing competitive advantage in technology manufacturing, the high degree of erosion in the U.S. manufacturing base, and the extent to which technology companies now depend on global supply chains. The latest in a series of White House actions to resolve this gap is President Biden's Executive Order on Securing America's Supply Chains, which orders review of six vulnerable sectors, including the ICT base.⁸²

The order partially responds to Information Technology and Innovation Foundation (ITIF) President Robert Atkinson's proposal for a targeted yet robust "industrial innovation strategy" that "fortifies traded-sector tech industries that are 'too critical to fail,'" such as advanced machinery, aerospace, biopharma, electrical equipment, semiconductors and computing, software, transportation.⁸³ Atkinson calls for strengthened federal institutions and Congressional actions such as tax and investment incentives and R&D financing to counter China's rise in technological advancements and manufacturing. Other experts point out a strengthened U.S. technology manufacturing base could generate deeper understanding of processes and new ideas to improve applications and bring R&D and manufacturing bases closer together.⁸⁴

The semiconductor industry, which merits special mention in the Supply Chains Executive Order, is an example of the complex challenges of reinvigorating technology manufacturing in the United States. Unlike other areas of high-tech production, China lags the United States and Taiwan in semiconductor design and manufacturing capacity, especially at TSMC, which designs and produces the most advanced chips in the world thanks to a unique blend of Taiwanese government and industry cooperation that fostered TSMC's rise.⁸⁵ While the 2021 global semiconductor shortage highlights the risks of single source supply chains, U.S. ability to innovate in this space and to attract manufacturing could strengthen its technology production base.

International Engagement: Redefining International Alliances for the Industry 4.0 Era

The accelerated deployment of AI technology globally has opened new opportunities for state and non-state actors to challenge the balance of power and the liberal character of the international order.⁸⁶ As we have done with transformative technologies of the past, it is imperative to create values-based frameworks to bolster that rules-based order. President Eisenhower appealed to the UN General Assembly in 1953 for the peaceful and ethical use of proliferating nuclear technologies: “I know that the American people share my deep belief that if a danger exists in the world, it is a danger shared by all – and equally, that if a hope exists in the mind of one nation, that hope should be shared by all.”⁸⁷ As we look at the collective dangers posed by AI, governments, private companies, and individuals in the United States and like-minded nations are pursuing various efforts to mitigate risks to privacy, civil rights, and security, while establishing and maintaining societal trust.⁸⁸ However, these efforts are weakly coordinated and lack agility.

On the liberal-democratic front, multiple regional, government-to-government, industry associations, and academic partnerships have adopted their own norms and standards. The aforementioned OECD AI Principles are just one of the many multilateral agreements on AI and related technologies. These norms, standards, and principles are important indicators of progress in societal discourse on AI’s existential challenges, even if important differences and enforcement challenges remain.

The **Chinese effort to expand influence in existing multilateral organizations** represents the clearest threat to wide-spread consensus on open, fair, transparent, and interoperable AI. President Xi Jinping views AI’s high-speed decisions as a competitive advantage deliberative democratic governance systems. Therefore, China is taking advantage of the *ad hoc* approach among liberal-leaning stakeholders to push aggressively for international support for its own authoritarian vision of AI, a central tenet to China’s quest to dominate and reform the global world order through military and commercial gains. Xi has bolstered state support to AI tech firms and R&D and cemented links between government, industry, and academia to speed China’s progress toward AI dominance. China has also adopted an “aggressive campaign to take

an active role within international AI standards-setting organizations in order to advance its agenda.”⁸⁹ Through the China Standards 2035 project, Xi seeks to capture broad commercial and security advantages abroad by overwhelming global standard-setting bodies such as the International Electrotechnical Commission (IEC) of the International Telecommunications Union (ITU) and the International Standards Organization (ISO).⁹⁰ At the same time, China seeks to accelerate its own efforts in AI by leveraging global industry and academic institutions through legal and illegal means.⁹¹

Current International Engagement Efforts on AI

Global efforts to address AI’s extensive challenges are abundant and multiplying. Though there are notable areas of overlap, the organizations focused on AI norms, standards, and principles can be grouped according to a “triple helix” model of government, industry, and academic institutions. Along with these bodies, government AI strategies, research laboratories, and global trade in technology all contribute to a complex international innovation system, each with a slightly different vision of ethical principles, technical quality standards, and norms of AI design, development, and deployment. The United States is engaging in a number of economic and security partnerships centered on AI or its related technologies:

Cooperative Economic Partnerships: The United States is engaging in important government-to-government partnerships to boost AI’s potential in commercial growth and science and technology cooperation. For example, the 2020 U.S.-Japan Digital Trade Agreement aims at advancing principles of “free and open data with trust” in light of exponential growth in digital trade.⁹² The language in this agreement mirrors that of the digital chapter of 2020 U.S.-Mexico-Canada Trade Agreement^e as well as the principles in the 2020 G20 Osaka Track principles of “free flow of data with trust.”⁹³ The agreements aim to achieve mutually beneficial outcomes for all participants, and in contrast with China’s self-interested actions. They also serve as important building blocks toward clear global rules to govern data collection, use, protection, and transfer for secure and commercially viable AI. The United States and others are rushing to partner with

^e The USMCA replaced the North American Free Trade Agreement (NAFTA) in 2020 and modernizes the free trade principals by which the United States, Mexico, and Canada conduct trade in goods and services.

India, the single most important potential counterweight to Chinese export of authoritarian AI models. India is the global leader in AI startups and boasts a \$167 billion software and back-end support service IT industry. For example, the November 2020 U.S.-India AI Initiative aims to promote “shared values of openness, transparency, reciprocity, and responsible AI development” to improve India’s AI’s capacity in R&D, skills, infrastructure, and education.⁹⁴

Cooperative Security Partnerships: Technology policy, including values-based limits on personal data and ethical standards, is shaping U.S. interactions with the UK, EU, and the informal Quadrilateral Security Dialogue (“the Quad”) with Japan, Australia, and India. For example, Quad partners pledged to enhance critical technologies collaboration using a values-based framework.⁹⁵ The Five Eye nations, an intelligence network of like-minded countries,^f are integrating cooperative technology development through the Technical Cooperation Program's AI Strategic Challenge and Project Maven.⁹⁶ The U.S. Department of Defense (DOD) launched the Joint Artificial Intelligence Partnership for Defense (PfD), as the primary actor working to expand cooperative efforts and form new security AI partnerships. As a corollary, DOD’s Joint AI Center (JAIC) is working to strengthen foundational principles’ interoperability and shared principles of morality in warfare through its AI PfD, which involves NATO members and other key allies Israel, Japan, ROK, Finland, and Sweden.⁹⁷ The 2020 Basic Exchange and Cooperation Agreement (BECA) between India and the United States promotes AI interoperability, enhanced sales, and transfers of high-end technologies.⁹⁸ India’s Army has been working with the U.S. military to develop drone swarm capability since 2018 and has demonstrated substantial progress toward combat effectiveness with drone.⁹⁹

Multinational corporations wield phenomenal power as they oversee huge supply chains, underwrite international research labs in advanced and emerging economies alike, engage in global trade in goods and digital services valued in the trillions of dollars, and help mold domestic and international regulatory and policy structures in their interests. Industry leaders play an important role in shaping and influencing AI standards and norms, not just through the actions of individual companies, but through international consensus building forums. Private

^f The Five Eyes countries are the United States, United Kingdom, Canada, Australia, and New Zealand.

sector representatives participate in technology standards such as the UN's ITU and its International Electrotechnical Commission (IEC) and the ISO. Chinese participation in these bodies outstrips that of other companies, including U.S. tech giants. Of leading global AI firms, only Google and Microsoft participate in the ISO committee responsible for standards, and no UK companies participate. Industry leaders have also established the Institute of Electrical and Electronics Engineer (IEEE), "the world's largest technical organization for the advancement of technology and the Open RAN (ORAN) Alliance, which advocates for secure alternatives to 5G telecommunications technologies."¹⁰⁰ Similarly, the world's technology leaders are relatively inactive in the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems.¹⁰¹

International Academic Partnerships: The open approach of academic research has promoted international collaboration on AI. Academic talent from around the world, including Turing award winners Geoff Hinton (British-Canadian), Yann LeCun (French), and Yoshua Benigo (Canadian), and their prodigies were instrumental in technological breakthroughs in AI research which have benefitted global industry. Leading U.S. AI research universities have many international partners to choose from, as traditional security partners such as Germany, Canada, Australia, New Zealand, and the UK all host leading AI research universities. However, in recent years, Chinese universities have begun to compete, and sometime surpass AI publication output and citation rates.^{102/103}

Opportunities to Promote Liberal Values in AI

The rapid and accelerating advancements in AI-driven decision-making has changed the international innovation environment, and the United States and other liberal-democratic countries have an opportunity to regain the upper hand through urgent, coordinated, and agile action. Partners and allies must strengthen efforts to synchronize approaches and norms across government, industry, and academia. For example, collaborative R&D programs, exchange programs, and workforce skills development programs that involve government, industry, and academia can promote trust and transparency, while fostering interoperability and mutual understanding. While existing fora will continue to make progress, new dynamic style of

groupings focused on AI and emerging technologies can accelerate progress and foster agility to address a range of shared challenges and deter disputes between partners.¹⁰⁴

AI policy experts are debating alternative approaches to build consensus to advance **democratic application of AI technologies**. For example, experts from the Brookings Institute advocate for the founding of a “**Community of Democracies**,” in which countries would make explicit commitments “to human rights, equality, the rule of law, freedom of speech, a free and independent press, and, above all else, the good of humanity” in the development and deployment of AI technologies.¹⁰⁵ The China Strategy Group, a think tank led by former CEOs of tech giants and senior U.S. policy makers advocates for the creation of the “**T12**,” a multilateral coalition of technology-leading democracies that “would help like-minded countries regain the initiative in global technology competition.”¹⁰⁶ The UK has proposed launching the **D10**,^g a formal grouping of the world’s “leading democracies” that would focus on 5G communications (which powers AI) and supply chains (which rely on AI).¹⁰⁷ The NSCAI Interim Report recommended a “**coalition of coalitions**”¹⁰⁸ approach, utilizing dynamic multilateral, bilateral and mini-lateral arrangements.¹⁰⁹ Ultimately, seamless integration of the global innovation base will necessitate a review of policy. William Greenwalt of the Atlantic Council highlights previous attempts to achieve this through National Technical Industrial Base (NTIB)^h legislation have fallen short.¹¹⁰

Key differences between the European Union and the United States present opportunity for further partnership. For example, while the EU GDPR¹¹¹ have resulted in high-profile investment disputes, other countries and U.S. states are increasingly drawing on GDPR as a model for their own regulatory approaches. By contrast, the National Security Council explicitly endorsed the EU AI Regulations of April 2021, which are the most comprehensive proposed regulatory frameworks in the world.¹¹² This opportunity for cohesion on an AI legal framework

^g The proposed initial members would be the United States, Japan, Germany, France, Britain and Canada, the Netherlands, South Korea, Finland, Sweden, India, Israel, and Australia.

^h The National Technology Industrial Base (NTIB) is a Congressionally mandated grouping of the people and organizations engaged in National Security and dual-use research and development production, maintenance, and related activities within the United States, Canada, the United Kingdom, and Australia.

has potential to foster new areas of cooperation and dialogue, in recognition that the United States and the European Union's shared values outweigh their differences.

Technology control over the weaponization of AI is the most crucial area for strengthened, multilateral, multistakeholder cooperation. In the 1950s, many leaders doubted if the Soviet Union, the United States, and the rest of the world could achieve binding agreements on nuclear arms control. While imperfect, the successful adoption of those agreements helped maintain relative peace and prevented a nuclear holocaust. Today, the rush by many countries, especially the United States, China, and Russia, to incorporate AI into defense systems is again elevating the risk of escalation to war and accelerating the potential speed of combat. Nowhere is the inherent tension between values and national security interests clearer. The United States has the 2020 U.S. DOD Ethical Principles for AI¹¹³ and cooperates with NATO and other key allies on common AI Ethics. However, there are no international norms limiting the use of AI in the development and deployment of weaponized AI systems.

The semiotic square in Figure 8 enumerates four possible U.S. and international policy options to guide consideration of binding international agreements or treaties on the use of AI-enabled weapons. The analysis concludes that obstacles to an international treaty on the responsible use of AI and emerging technologies in war are strong, especially those regarding the verifiability and enforceability.¹¹⁴ However, it also concludes the absence of such agreements would send a risky global signal that could ultimately weaken international cohesion and lead to fatal consequences. For example, **binding international standards for the use of AI in war could encourage de-escalatory actions prior to conflict**, avoid miscalculation, and promote trust and transparency between nations. Universal recognition of the Law of Armed Conflict to guide the military development of AI and emphasizing the protection of non-combatants decreases the likelihood of escalation. (Annex C contains additional analysis.)

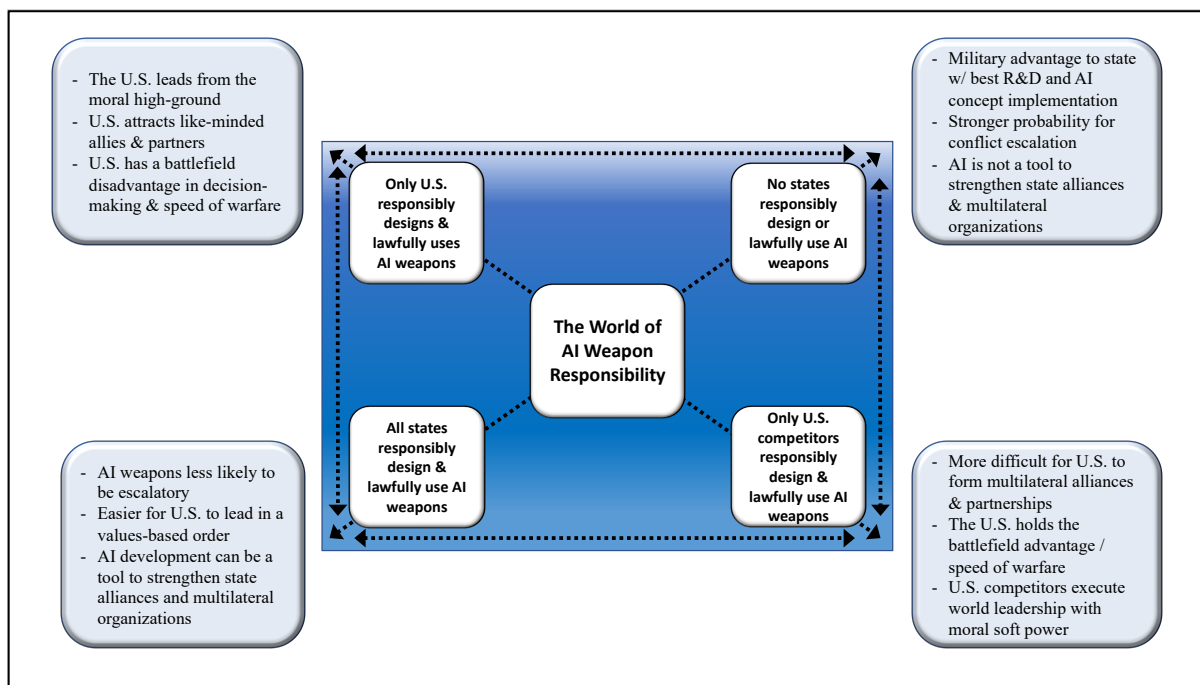


FIGURE 8: SEMIOTIC SQUARE ANALYSIS OF TECHNOLOGY CONTROLS POLICY CHOICES AND RISKS

Policy Recommendations

I. Increase AI Multilateral Engagements and Partnerships

International Standards and Global Integration

(1) Accelerate efforts to establish a **‘Digital Coalition of Democratic States and Private Sector’** to coordinate efforts on AI and other emerging technologies. As highlighted by the NSCAI, establishing such “coalition of coalitions” will strengthen “[c]ollaboration among democratic nations and is a strategic imperative to counter China’s efforts and to realize the potential of AI to improve lives, to grow innovative industries, to empower workers, and to increase national security.” Implementation will require multiple lines of effort:

- **Governance and core members.** The White House OSTP leads a U.S. campaign to establish the Digital Coalition with founding members from leading AI research and development nations, including the United Kingdom, France, Germany, and Canada, Israel, India, Japan, and Australia. Departments of State, Commerce, and Defense lead U.S. implementation and action.

- **Industry participation.** Core members agree on multinational corporation and academic institution representation. Industry representatives provide advice and guidance on key issues, monitor performance in standards organizations, and recommend ways to enhance government and industry participation in international technical standards bodies such as the IEC of the ITU, ISO, and 3rd Generation Partnership Project (3GPP) to counter China's aggressive coordination of its representatives from enterprises and government.
- **Academic collaboration.** Digital Coalition members host collaboration forums, encouraging leading academic institutions to discuss curriculum and implementation of OECD principles, challenges, and best practice, and enable academic institutions to share insights on foreign intelligence operations.
- **Talent exchange program.** The core members establish a talent exchange program for government agencies and academia. This includes expanding the number of exchange officers in the JAIC, faculty for the Digital Services Academy, and other national security research and development initiatives.
- **Policy task force.** The NTIB has demonstrated the challenges of global integration of innovation and the industry base.¹¹⁵ OSTP should establish a task force to identify barriers and recommend policy updates to enable the Digital Coalition and support the intent to form agile mini-lateral coalitions.

(2) Draft and seek formal adoption in the United Nations of **binding international agreements or treaties on the development and deployment of military applications of AI**. The treaty language should address the boundaries of “human in the loop” in autonomous weapons, keeping AI away from nuclear operational command and control, the Law of Armed Conflict including AI weapons, prioritizing civilian safety, the extent of tolerable human-machine interface,¹¹⁶ and proper safeguards on the suppression of emotions and feelings.¹¹⁷ AI weapons treaties must be **verifiable and enforceable** to the maximum extent possible. Given all leading AI countries must participate, the development of such agreements presents opportunities for cooperation with China and Russia.

(3) Prioritize new **digital trade agreements** with the UK, the EU, and Taiwan modeled after the 2020 U.S.-Japan Digital Services agreement and the digital chapter of the new USMC to promote U.S. commitment to values-based leadership in concepts of flow of data with trust.

II. Enhance Domestic AI Innovation

Regulation

(4) Task OSTP to lead a public-private, collaborative effort to establish key guidelines for conduct across the following key domestic regulatory shortfalls:

- Explore the establishment of a dedicated federal agency to direct emerging technology development and use.
- Provide executive branch support to a **federal-level Basic Privacy Law** and to reforms of section 230 of the Communications Decency Act, by clearly defining industry responsibilities in the collection, storage, and transfer of data to protect individual civil liberties.^{118/119}
- Adopt **federal principles for the responsible use of facial recognition** and work with Congress to pass privacy legislation in this domain.

R&D and Domestic Production

(5) Strengthen the U.S. innovation system by passing and resourcing the Endless Frontier Act to promote U.S. leadership in key technologies like AI by authorizing \$100 billion over five years, for investments in “basic and advanced research, commercialization of research, and education and training programs.”^{120, 121}

- **Scale federal funding of R&D** to no less than one percent of GDP, overcoming long-running declines.
- Maintain defense-related R&D spending at or above \$105 billion in FY 2021, at least three percent of which should target science and technology; reallocate \$8 billion annually to AI innovation R&D from readiness (operations and maintenance) investments.¹²²
- Fund national research labs and DOD research facility improvements for **cutting edge AI research, including 5G wireless and Open RAN connections.**

- **Simplify and expand the R&D Tax Credit** or private R&D to make it more attractive and accessible to small businesses.

(6) Deploy a coherent **industrial strategy** as part of the President’s American Jobs Plan that identifies key manufacturing needs of the future U.S. economy, prioritizes key technology trends shaping the Industry 4.0 economy, and ensures regulation and financial incentives that inspire private business to act.

- Empower the Department of Commerce to manage and implement this effort by **prioritizing sectors and industries of focus for investment** in advanced manufacturing R&D and low-interest loans to small- and medium-sized domestic manufacturing enterprises.
- Pursue aggressive **tax credits to businesses investing in education and reskilling** for workers displaced by AI technologies.
- Fund the **aggressive development and deployment of supporting technologies**, like next generation wireless technology, to achieve the intent of The National Strategy to Secure 5G and facilitate implementation.

Diversity and Talent Management

(7) **Fund new education initiatives and workforce transition programs and update immigration policies** to bolster AI talent.

- **Provide incentives to study AI-related STEM fields** at both the K-12 and university level by funding scholarship programs and offering financial incentives to state universities that produce graduates in critical fields.
- **Enhance the pool of STEM teachers** through extended federal support and endorsement of programs like the ‘100,000 in 10 Program,’ which is on track to exceed its goal of training, developing, and retaining 100,000 quality STEM teachers by the end of 2021.
- **Increase funding to the White House Initiative on HBCUs for R&D** focused on AI and related emerging technologies to align research centers in minority communities.

- Remove immigration barriers that impede a return on investment in foreign-trained STEM talent. **Streamline and rebalance immigrant and non-immigrant policies** and regulations that deter STEM talent from studying and working in the United States.
- **Invest to retrain and reskill workers displaced by automation and AI related technologies** through public-private partnerships, including career counseling to help workers navigate the shifting job market landscape. Improve the social safety net for those suffering financially from job loss, create certification programs on AI-relevant analysis skills, and create a life-long learning mechanism to encourage reskilling.¹²³

Conclusion

Securely and transparently harnessing benefits of AI and the Fourth Industrial Revolution has the potential to bestow **real competitive advantages** to companies and countries that demonstrate they will **responsibly handle personal data and information**. Investors and private citizens alike will ultimately demand **transparency and accountability** for the deployment of AI-enabled applications, especially those involving sensitive data like financial transactions, health information, and law enforcement information. **Such an ethics-based approach will not only build trust in government, but also help the bottom line of companies that can market and reliably adhere to standardized, values-based regulations.**

It is imperative the U.S. government, in conjunction with international partners, allies, and the private sector, **seize the moral high ground and accelerate a values-based global AI approach** that clearly distinguishes us from China, and the heavy-handed use of AI that authoritarian nations are embracing. Furthermore, we must look not just to galvanize like-minded partners and allies, but influence and encourage the adoption of these standards world-wide.

Naysayers and “realists” may argue that a values-based approach does not sufficiently or fully address American interests, and that China’s narrow, nationalistic approach to data harvesting and AI applications provides them with some insurmountable advantages. They are wrong. The ethical application of AI technology will place the United States squarely in a position of

leadership and competitive advantage on a path to a healthier, more connected, and more prosperous world. Without a values-based approach, AI has the potential to increase suffering, ignite conflict, and widen the gap between rich and poor. **In which world do you want to live?**

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Annexes

Annex A: AI Legislation and Policy in the United States

Executive Orders

Executive Order 13859 Maintaining American Leadership in Artificial Intelligence.

Maintaining American leadership in AI requires 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. It is the policy of the United States Government to sustain and enhance the scientific, technological, and economic leadership position of the United States in AI R&D and deployment through a coordinated Federal Government strategy.

Executive Order 13873 **Securing the ICT and Services Supply Chain.** foreign adversaries are increasingly creating and exploiting vulnerabilities in information and communications technology and services, which store and communicate vast amounts of sensitive information, facilitate the digital economy, and support critical infrastructure and vital emergency services, in order to commit malicious cyber-enabled actions, including economic and industrial espionage against the United States and its people. To deal with this threat, additional steps are required to protect the security, integrity, and reliability of information and communications technology and services provided and used in the United States.

Executive Order **13960 Promoting Trustworthy Artificial Intelligence.** The ongoing adoption and acceptance of AI will depend significantly on public trust. Agencies must therefore design, develop, acquire, and use AI in a manner that fosters public trust and confidence while protecting privacy, civil rights, civil liberties, and American values, consistent with applicable law and the goals of Executive Order 13859. EO 13960 establishes principles for the use of AI in the Federal Government, establishes a common policy for implementing the principles, directs agencies to catalogue their AI use cases, and calls on General Services Administration (GSA) and the Office of Personnel Management to enhance AI implementation expertise at the agencies.

America's Supply Chains – Request for Comment. Secretary of Defense (as the National Defense Stockpile Manager pursuant to the Strategic and Critical Materials Stock Piling Act), in consultation with the heads of appropriate agencies, shall submit a report, within 100 days, identifying risks in the supply chain for strategic and critical materials as well as policy recommendations to address these risks.

Strategy Documents

National Strategy for Critical and Emerging Technologies

National Strategy to Secure 5G

National Cyber Strategy

National Artificial Intelligence Research and Development Strategic Plan

Department of Defense Artificial Intelligence Strategy

U.S. Department of Homeland Security Artificial Intelligence Strategy

Reports

National Security Commission on Artificial Intelligence – Final Report

American Artificial Intelligence Initiative: Year One Annual Report

AI Related Bills

Artificial Intelligence in Government Act of 2020 codifies into law the GSA AI Center of Excellence, which was launched in 2019. It further calls on the Office of Management and Budget to provide guidance for agency use of AI, and for the Office of Personnel Management to update the occupational series for AI for Federal employees.

The **National Defense Authorization Act for Fiscal Year 2021**. The \$741 billion defense policy bill garnered bipartisan support in both the House and Senate: the votes were 335 to 78 and 84 to 13, respectively. The bill includes a number of provisions related to AI and emerging technology, including:

- The **National Artificial Intelligence Initiative Act 2020**, which directs the president to establish a National Artificial Intelligence Initiative to support U.S. leadership in AI. The measure authorizes approximately \$5 billion for National Science Foundation AI research and education grants, as well as more than \$1 billion for Department of Energy AI research.

- Provisions from the **CHIPS for America Act** to support the development and production of semiconductors in the United States. The included provisions direct DOD to establish a public-private consortium for the development of chips. They also authorize a fund to advance microelectronics research with allies and partners, provided those partners enact controls on chip exports to China.

On March 4, a bipartisan group of Senators introduced the **Democracy Technology Partnership Act**. The bill aims to confront China’s technological influence by creating a partnership of democratic countries that would set international standards and coordinate export controls on critical technologies, including artificial intelligence. Sens. Bennet, Cornyn, Menendez, Rubio, Sasse, Schumer and Young joined lead sponsor Sen. Warner in co-sponsoring the bill, which would establish an International Technology Partnership Office at the State Department — headed by a Special Ambassador for Technology and staffed by officials from various agencies — tasked with building the “technology-based partnership of democratic countries.” The act would also establish a \$5 billion fund for supporting joint research projects and investing in technology in third-country markets.

Chairwoman Johnson of the House Committee on Science, Space, & Technology introduced the **National Science Foundation for the Future Act**, which would double NSF’s budget over the next five years. It would also establish a new “Directorate for Science and Engineering Solutions” within NSF with an annual budget that would grow to \$5 billion over five years. The directorate would focus on "societal and national challenges" including climate change, cybersecurity, social and economic inequality, and workforce development, among others.

The **Endless Frontier Act** re-introduced last week by Sens. Schumer and Young and Reps. Khanna and Gallagher, would direct \$100 billion in new funds to the National Science Foundation and establish a new directorate within the agency focused on R&D in key fields, including AI. A Senate Commerce markup of the bill originally scheduled for this week has been postponed. (We covered a Senate hearing on the bill earlier this month.)

The **Safeguarding American Innovation Act**, re-introduced by Sens. Portman and Carper, would address economic espionage and research security.

The **Fourth Amendment Is Not For Sale Act**, introduced last week by Sens. Wyden and Paul, would block federal agencies from buying personal data without a warrant or paying for services like Clearview AI that gather public information for tracking purposes.

The **STEM RESTART Act**, introduced by Sens. Hyde-Smith, Kelly and Rosen and Reps. Houlahan and Baird in the House, would provide funds for mid-career workers to transition or return to jobs in the STEM workforce.

The **SECURE CAMPUS Act**, introduced by Sen. Cotton in the Senate and Rep. Kustoff in the House, would bar Chinese nationals from receiving visas for graduate and post-graduate studies in STEM fields.

The **AI Scholarships-for-Service Act**, re-introduced by Sens. Thune and Peters, would fund scholarships for students in AI-related fields in exchange for public service after graduation.

The **Investing in Tomorrow's Workforce Act**, introduced by Sens. Durbin and Warnock in the Senate and Rep. Bustos in the House, would address automation-related job losses through increased workforce training.

The **Combating Chinese Purloining of Trade Secrets Act**, introduced by Sen. Graham, would impose stricter penalties on individuals engaged in economic espionage and tighten visa restrictions for Chinese citizens looking to pursue national security-relevant graduate coursework in the United States.

The **National Strategy to Ensure American Leadership Act**, introduced by Sens. Van Hollen and Blunt, requires the National Academies of Sciences, Engineering and Medicine to identify the top ten emerging technology challenges facing the United States and issue policy recommendations to address each challenge.

The **Advancing American AI Act**, introduced by Sen. Peters, aims to promote AI adoption and encourage AI-related programs within the federal government.

The **Rural STEM Education Act**, introduced by Sens. Wicker and Rosen, would direct the National Science Foundation to fund STEM teacher training and evaluate programming for STEM education in rural areas.

The Senate Foreign Relations Committee approved the **Strategic Competition Act of 2021** by a 21-1 vote. It will head to the full Senate for consideration. (We also covered a hearing on this bill earlier this month.)

Regulation of AI

Office of Management and Budget Memorandum **Guidance for the Regulation of Artificial Intelligence Applications**. This Memorandum sets out policy considerations that should guide, to the extent permitted by law, regulatory and non-regulatory approaches to AI applications developed and deployed outside of the Federal government.

- A. **Key AI Industry Players**
- B. **CVF (Values)**
- C. **Semiotic Square (for Technology Controls)**
- D. **International Innovative System**

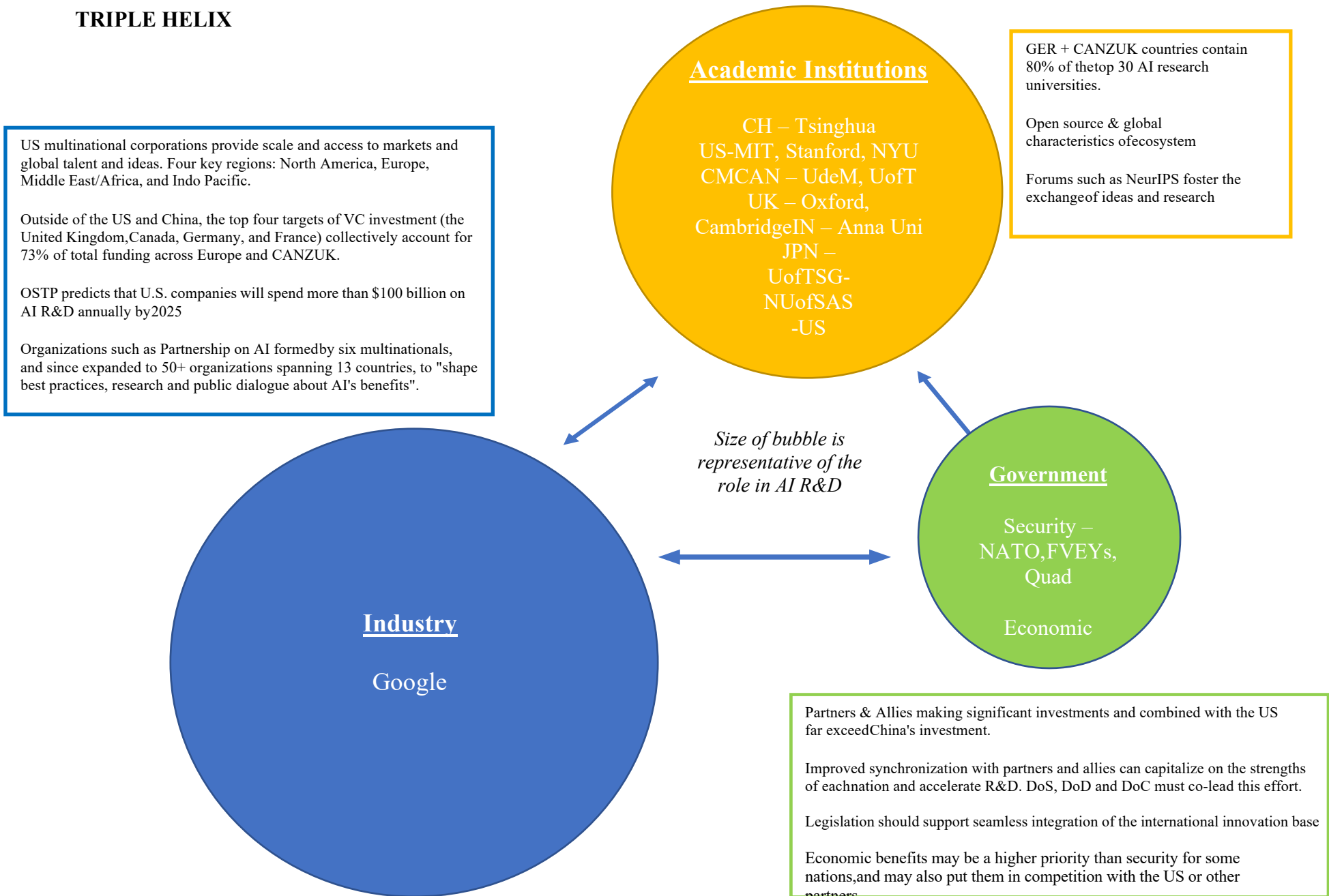
Annex B: International Innovation System

Countries Leading AI Research

1. United States
2. China
3. United Kingdom
4. Canada
5. France
6. Germany
7. Switzerland
8. South Korea
9. Japan
10. Israel
11. Australia
12. Singapore
13. India
14. Italy
15. Russia
16. Sweden
17. Netherlands
18. Austria
19. Denmark
20. Saudi Arabia

Source: <https://chuvpilo.medium.com/ai-research-rankings-2020-can-the-united-states-stay-ahead-of-china-61cf14b1216>

TRIPLE HELIX



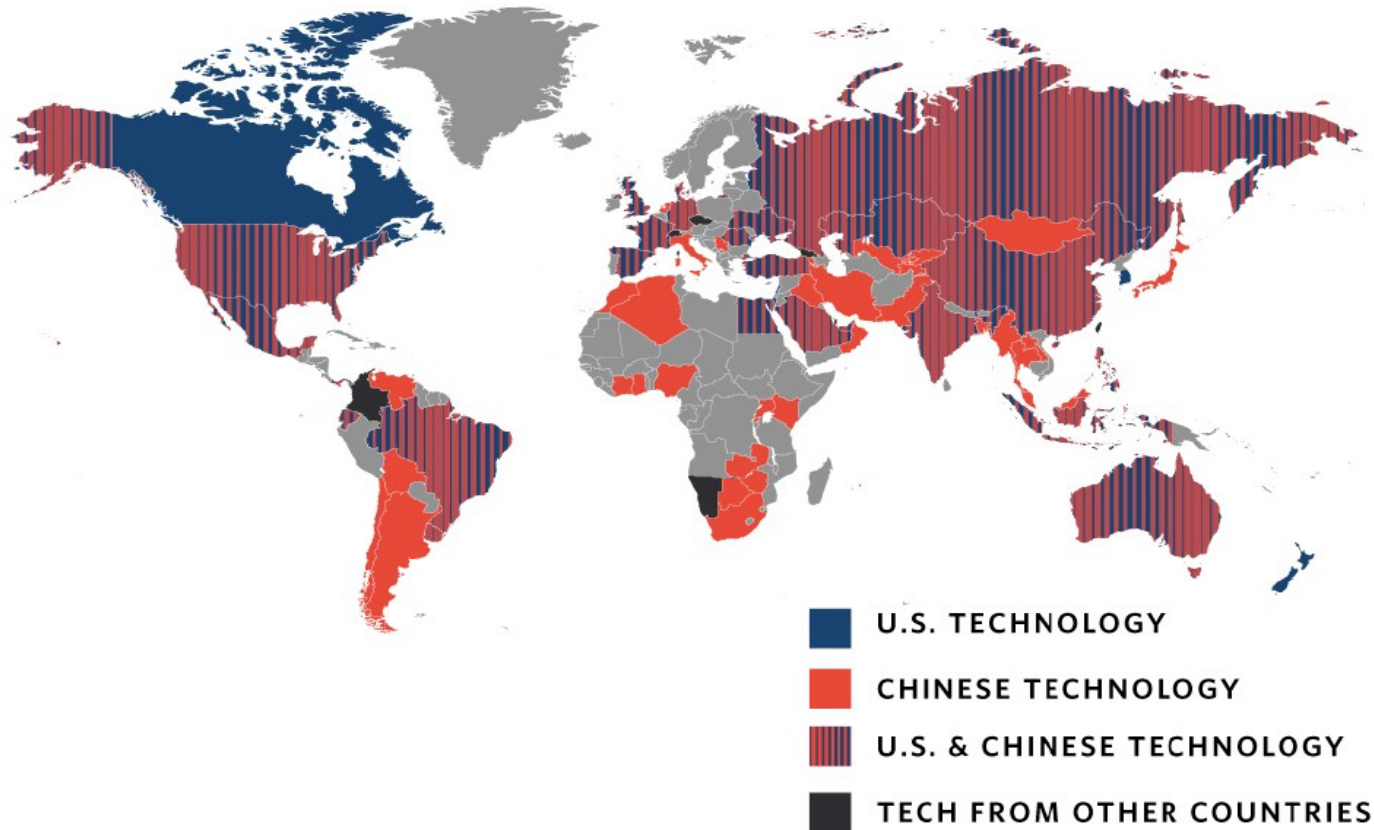
AI STRATEGIES

To guide and foster the development of AI, countries and regions around the world are establishing strategies and initiatives to coordinate governmental and intergovernmental efforts. Since Canada published the world's first national AI strategy in 2017, more than 30 other countries and regions have published similar documents as of December 2020.



Source: <https://aiindex.stanford.edu/report/>

AI Surveillance Technology Origin



Notes

- The AIGS Index presents a country-by-country snapshot of AI tech surveillance with the majority of sources falling between 2017 and 2019. Given the opacity of government surveillance use, it is nearly impossible to pin down by specific year which AI platforms or systems are currently in use.

Source: <https://carnegieendowment.org/2019/09/17/global-expansion-of-ai-surveillance-pub-79847>

INTERNATIONAL ENGAGEMENT

GOVERNMENT

Technology Standards &

Norms:

OECD

OECD.A

IGPAI

ITU

ISO

IEE

E

Economic:

- G7

- G20

China Challenge:

IPA

CD-

10

Security:

JAIC Partnership for Defense

NATO

FIVE EYES eg. TTCP

INDUSTRY

ITU/ISO/3GPP

Partnership on AI

ORAN Alliance

5G Futures Forum

ANSI InterNational Committee
for InformationTechnology

Standards (INCITS)/AI

International Neural

Network Society

- European Neural
Network Society

- Japanese Neural
Network Society

AI Board of America AI &
ML Engineering Excellence
Standards

ACADEMIC

Curriculum

Publications

Large International
Conferences: NeurIPS

IROS

ICML

CUPR

AAAI

IJCAI

ICRA

Small International
Conferences:

ICLR

AAMS

ACL

KR

ICAPS

Source: <https://www.nscai.gov/wp-content/uploads/2021/01/NSCAI-Interim-Report-and-Third-Quarter-Recommendations.pdf>

Source: <https://cset.georgetown.edu/publication/agile-alliances/>

Source: <https://www.ai.gov/>

Source: <https://aiindex.stanford.edu/report/>

Source: Genius Makers by Cade Metz

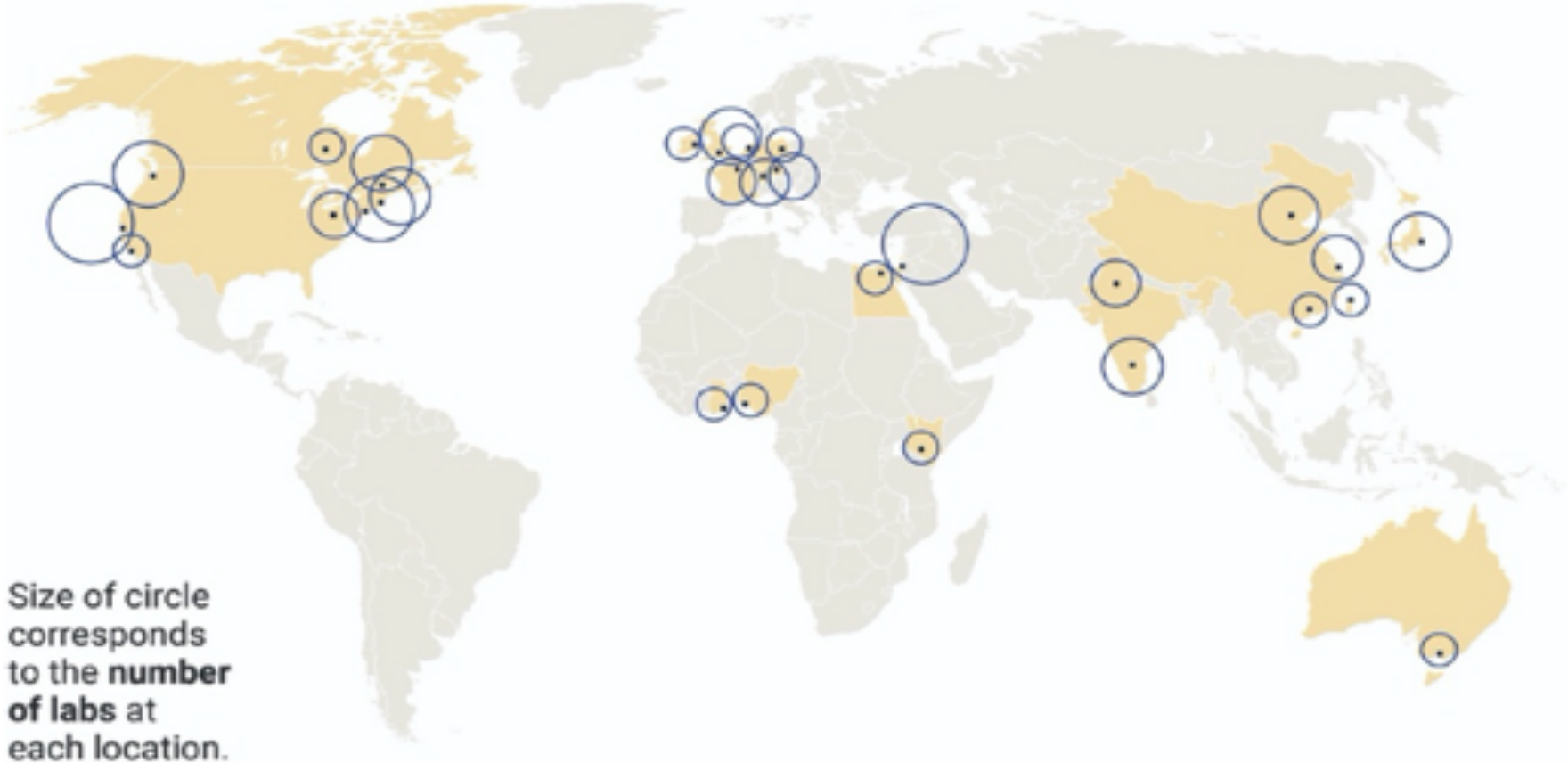
Top 100 Global Companies Leading in AI Research in 2020:

(Abbreviated for the purposes of this annex)

1. Google (USA)
2. Microsoft (USA)
3. Facebook (USA)
4. IBM (USA)
5. Huawei (China)
6. NVIDIA (USA)
7. Amazon (USA)
8. Samsung (South Korea)
9. Alibaba (China)
10. Tencent (China)
11. Yandex (Russia)
12. Apple (USA)
13. OpenAI (USA)
14. Baidu (China)
15. Criteo (France)
16. Uber (USA)
17. Intel (USA)
18. Salesforce (USA)
19. Adobe (USA)
20. Qualcomm (USA)
21. Bosch (Germany)
22. NEC (Japan)
23. SenseTime (China)
24. JD (China)
25. Flatiron Institute (USA)
26. Bytedance (China)
27. Element AI (Canada)
28. Naver (South Korea)
29. NTT (Japan)
30. AITRICS (South Korea)

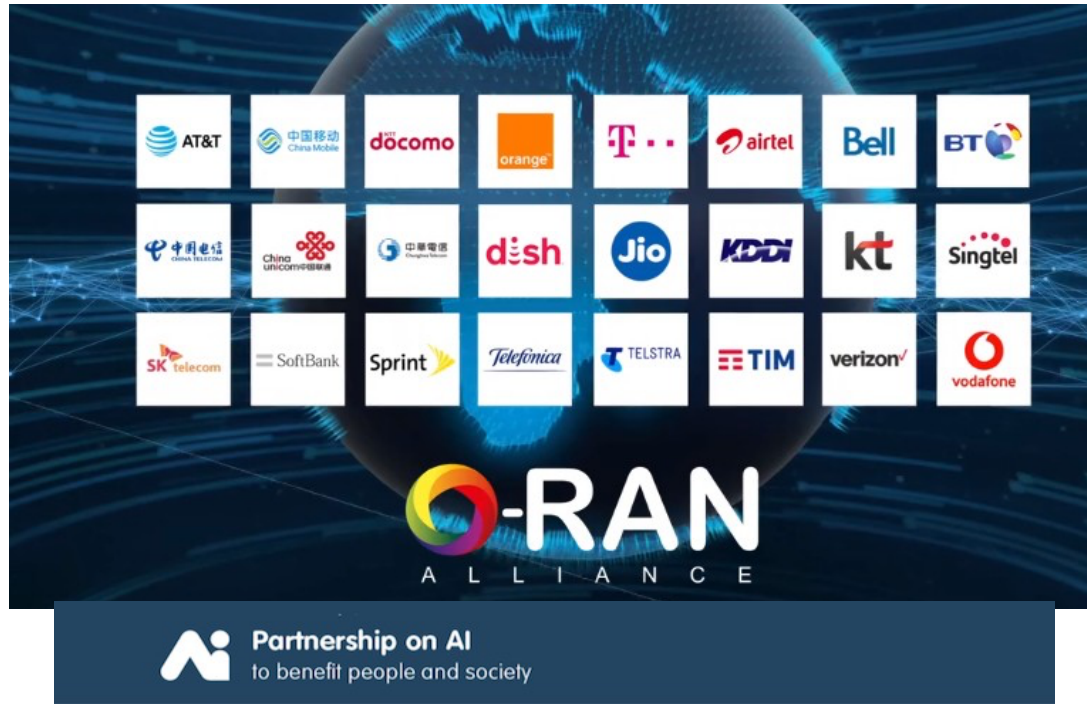
Source: <https://chuvpilo.medium.com/ai-research-rankings-2020-can-the-united-states-stay-ahead-of-china-61cf14b1216>

Figure 4. Global distribution of AI labs by location.



Source: <https://cset.georgetown.edu/publication/mapping-u-s-multinationals-global-ai-rd-activity/>

GLOBAL INDUSTRY ALLIANCES



Top 100 Global Universities Leading in AI Research in 2020:

(Abbreviated for the purposes of this annex)

1. Stanford University (USA)
2. MIT (USA)
3. UC Berkeley (USA)
4. Carnegie Mellon University (USA)
5. University of Oxford (UK)
6. Tsinghua University (China)
7. Princeton University (USA)
8. UT Austin (USA)
9. ETH (Switzerland)
10. EPFL (Switzerland)
11. Harvard University (USA)
12. Cornell University (USA)
13. Columbia University (USA)
14. New York University (USA)
15. UC Los Angeles (USA)
16. University of Illinois at Urbana-Champaign (USA)
17. KAIST (South Korea)
18. University of Cambridge (UK)
19. UC San Diego (USA)
20. Peking University (China)
21. University of Pennsylvania (USA)
22. Duke University (USA)
23. National University of Singapore (Singapore)
24. Georgia Institute of Technology (USA)
25. University of Maryland (USA)
26. University College London (UK)
27. University of Washington (USA)
28. University of Toronto (Canada)
29. Technion (Israel)
30. University of Michigan (USA)

ATTENDANCE at LARGE AI CONFERENCES, 2010-20

Source: Conference Data | Chart: 2021 AI Index Report

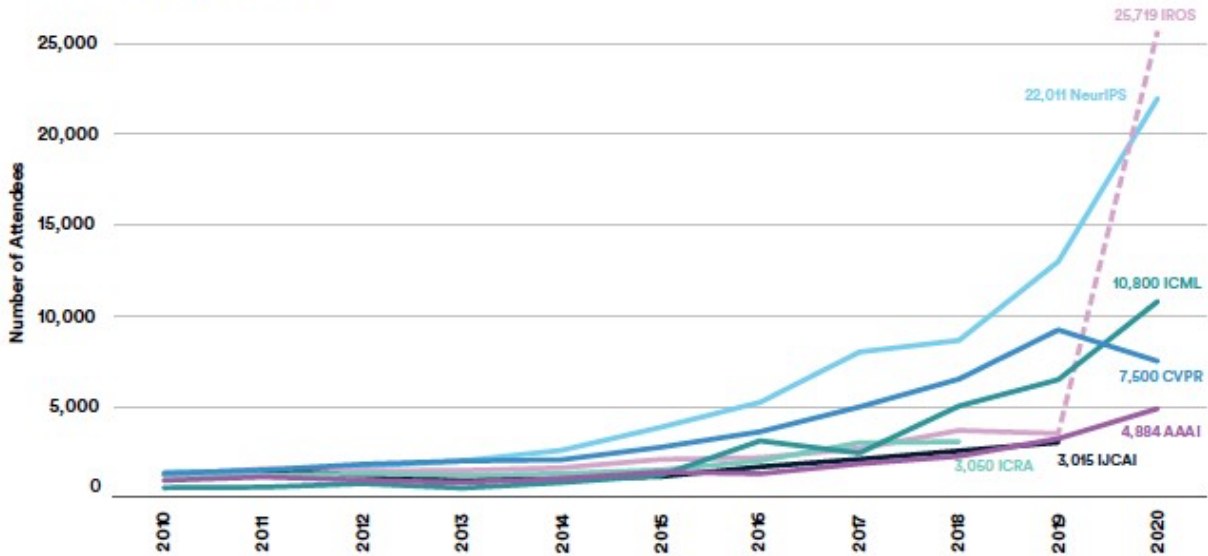
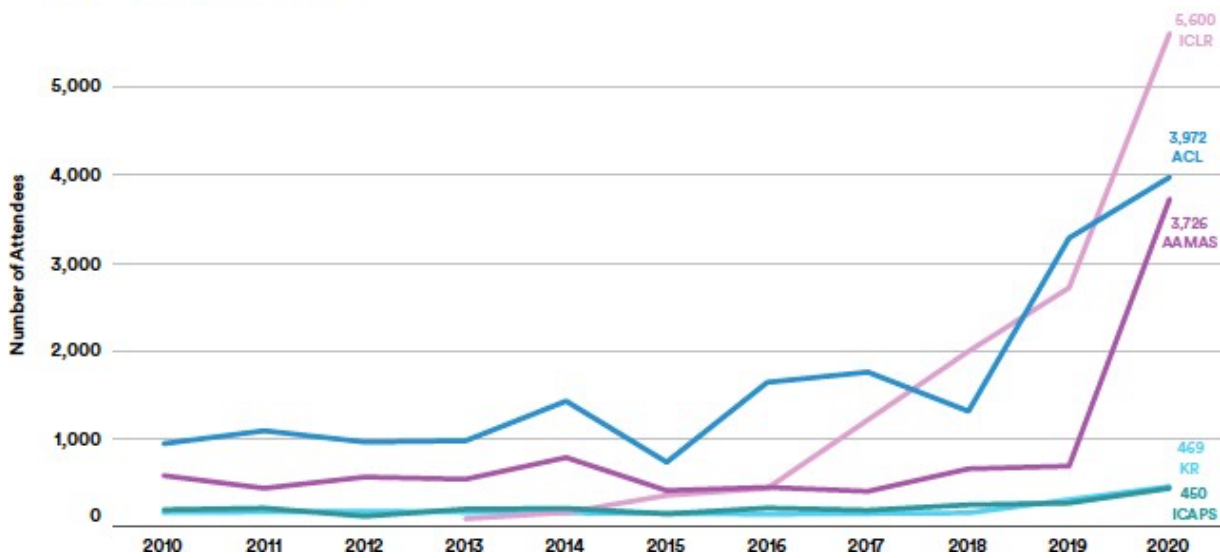


Figure 1.2.1

ATTENDANCE at SMALL AI CONFERENCES, 2010-20

Source: Conference Data | Chart: 2021 AI Index Report



Source: <https://aiindex.stanford.edu/report/>

By Geographic Area

Figure 1.1.9 shows that among the three major AI powers, China has had the largest share of AI journal publications in the world since 2017, with 18.0% in 2020, followed by the United States (12.3%) and the European Union (8.6%).

AI JOURNAL PUBLICATIONS (% of WORLD TOTAL) by GEOGRAPHIC AREA, 2000-20

Source: Microsoft Academic Graph, 2020 | Chart: 2021 AI Index Report

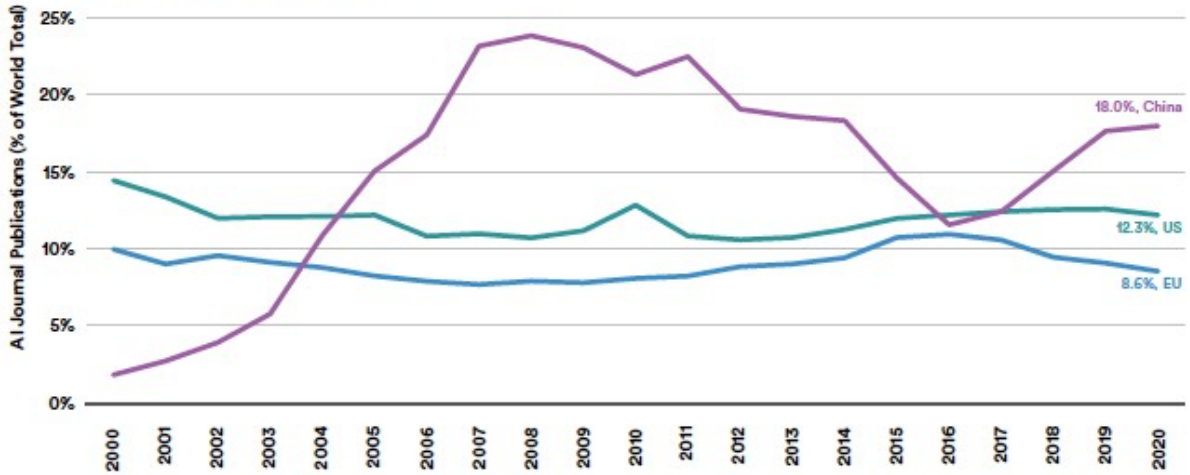


Figure 1.1.9

Citation

In terms of the highest share of AI journal citations, Figure 1.1.10 shows that China (20.7%) overtook the United States (19.8%) in 2020 for the first time, while the European Union continued to lose overall share.

AI JOURNAL CITATIONS (% of WORLD TOTAL) by GEOGRAPHIC AREA, 2000-20

Source: Microsoft Academic Graph, 2020 | Chart: 2021 AI Index Report

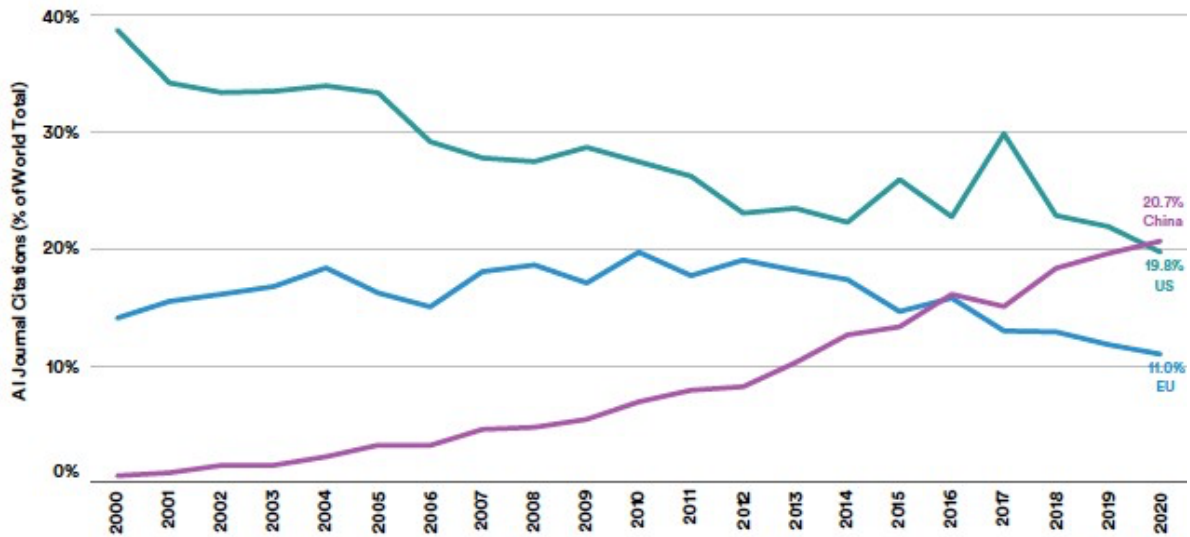
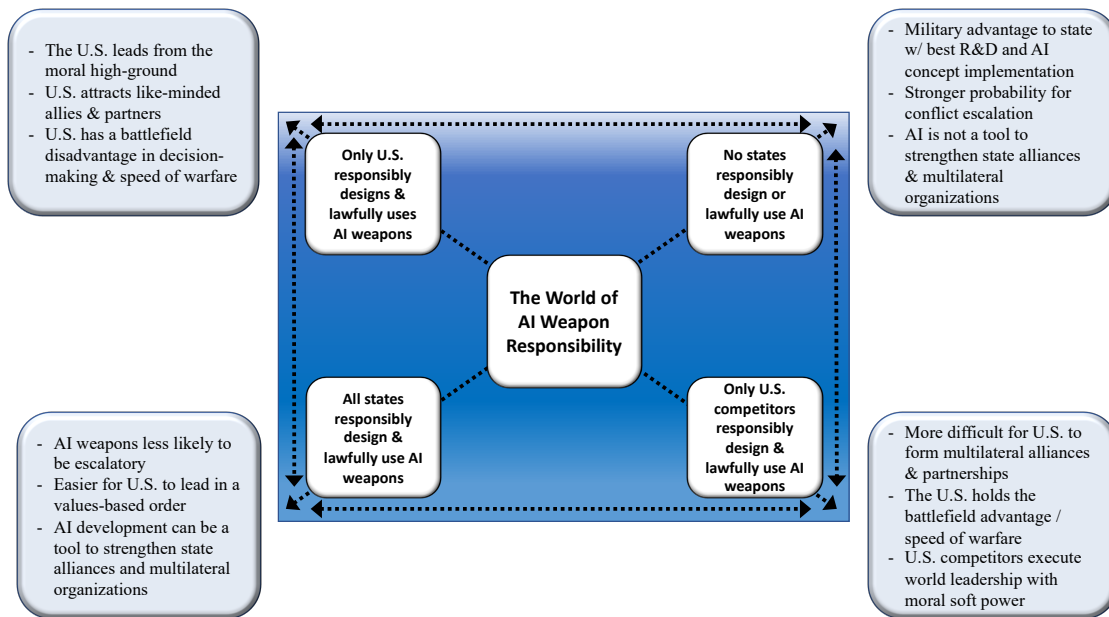
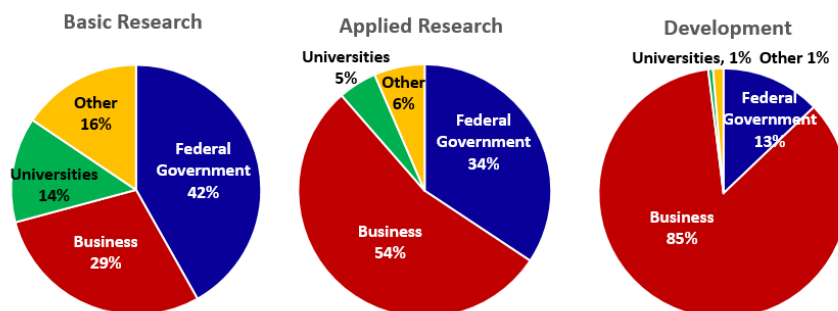


Figure 1.1.10

Source: <https://aiindex.stanford.edu/report/>

Annex C: Semiotic Square Analysis of Technology Control Policy Risks

If the United States decides to seek international treaties on AI weapons and is subsequently unable to get potential adversaries to agree to design and use AI weapons responsibly, the soft-power consequences are positive while the hard-power consequences lean negative. The United States would still lead from the moral high-ground and would be able to attract like-minded allies and partners. However, an adversary that did not restrain itself could potentially have a battlefield advantage in decision-making and execution speed. The opposite would occur if an American adversary chose the values-based approach to AI weaponry and the United States did not. However, the most informative corners of the semiotic square are the two that represent the case where ALL states employ AI weapons responsibly designed and lawfully used and ZERO states employ AI weapons responsibly designed and lawfully used. No restraints on AI weapons translates to a stronger probability for conflict escalation and statesmen miscalculation. Additionally, nations cannot use AI as a tool to strengthen alliances or multilateral agreements/organizations.

Annex D: U.S. Research by Funding Sector

U.S. RESEARCH BY FUNDING SECTOR, 2018

Source: John Sargent, Jr., *Federal Research and Development (R&D) Funding: FY2021*, CRS Report for Congress R46341 (Washington, DC: Congressional Research Service, December 17, 2020), 6, <https://crsreports.congress.gov/product/pdf/R/R46341/13>.



Disclaimer and Explanation
Length of Seminar 7 IS Paper 2021

Seminar 7 AI Industry Study 2021 for readability purposes used 1.15 lines vice pure single spacing and incorporated numerous charts and figures and graphs within the text

The actual text word count of text is 9375, consistent with the guidance of 20 page single-spaced length.

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James M. Keagle