

# U.S. AI Policy – A Balancing Act

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## ABSTRACT

Artificial intelligence policy is emerging as a critical component of U.S. strategy and strategies for countries around the world. What type of AI policy will allow the United States to continue to lead the world in AI innovation while doing it in an ethical and responsible manner? This work compares and contrasts 13 different countries and how each government approaches innovation, regulation, government funding, and law scope in the field of artificial intelligence. A significant portion of this analysis evaluates the tradeoffs that come with AI policies and their effects on society. Considering these tradeoffs, the U.S. needs to ensure that innovation in the field of artificial intelligence remains the top priority, while at the same time balancing the ethical deployment of AI to protect U.S. citizens. With China on the heels of the United States in terms of artificial intelligence capabilities, the United States needs to innovate more in the fields of foundation models, generative AI, human machine interaction, natural language processing (NLP), computer vision, and other emerging areas of artificial intelligence as well.

This thesis takes an in-depth analysis of foundation models and generative artificial intelligence, while highlighting their importance and demonstrating their potential impact in the future. At the end of this body of work, there is a proposed Bill to U.S. lawmakers and Congress, titled “The Artificial Intelligence Startup, Innovation, Defense, Industry, and Academia Act (AI STIDIA Act)” that proposes a strategy for the United States to drive significant innovation in the field of artificial intelligence while deploying it in an ethical and responsible manner. The United States needs to prioritize ethical innovation in the field of artificial intelligence and cannot afford to emplace ineffective regulatory frameworks that curtails innovation. There will be a time when there is proper technology to extensively regulate artificial intelligence; however, there is not sufficient technology to extensively regulate AI as I publish this thesis. As the United States aims to generate the most innovative AI systems and create a culture that encourages the ethical deployment of AI, we should learn from past successes and failures when innovating technology. The United States needs to focus on creating AI technologies that enhances the wellbeing of U.S. citizens and people around the world.

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# Introduction

“Artificial intelligence can be a massive force for good in society, but now is the time to ensure that the AI we build has human interests at its core.”<sup>1</sup>

- Eric Schmidt, Former Google CEO and Chair of the National Security Commission on Artificial Intelligence

Artificial intelligence is a technology that is transforming our world in unprecedented ways. AI is changing how the global economy functions, how companies operate, and how humans interact with each other. The field of artificial intelligence is complex and is constantly changing. It is important to highlight what artificial intelligence is, how it functions, and how it is used in society. There are many different definitions for artificial intelligence; however, in this work I will provide my own artificial intelligence definition and interpret it. Also, there is a difference between artificial intelligence and artificial intelligence policy that needs to be distinguished. Therefore, I will define them both and also define key terms that impact artificial intelligence and artificial intelligence policy.

Artificial intelligence policy is a dynamic and complex topic to understand because one must not only understand the technical attributes of artificial intelligence, but the components of policy and how governing bodies establish these policies. Therefore, established definitions must be provided to increase clarity on the topic. It is important to note that these definitions may not be accepted by all; however, these definitions are provided below to bring clarity to the dynamic topic of artificial intelligence policy.

## Definitions:

**Artificial Intelligence: Artificial intelligence is a software that takes given inputs (information) and returns a calculated output (a prediction), based on data and information the software has previously seen to achieve a predefined goal.**

Artificial intelligence is taking information that we have collected and uses this information to generate information that we don't have (a prediction). AI is an umbrella term that encapsulates machine learning, which is an algorithm designed to choose the best function, from a set of possible functions, to explain the relationships between features in a data set. There are several types of machine learning to include supervised (Task driven machine learning that predicts the next value), unsupervised (Data driven machine learning that identifies clusters), self-supervised learning (data taken as inputs that generates labels automatically) and reinforcement learning (machine learning that learns from mistakes).<sup>2</sup>

Generative AI models like OpenAI's ChatGPT and Stability AI's Stability Fusion model have recently transformed the artificial intelligence landscape. These generative AI models, like ChatGPT are called “generative” because they can generate new text based on the input they

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<sup>1</sup> Sam Shead. “Eric Schmidt plans to give A.I. researchers \$125 million to tackle hard problems”. *CNBC*, 2022.

<sup>2</sup> Ajay Agrawal. “Prediction Machines: The Simple Economics of Artificial Intelligence”. *Harvard Business Review*, 2018.



receive.<sup>3</sup> These generative AI models also have the capability to create text-to-image programs, like DALL-E and Stability AI that have the potential to change how art, animation, and movies are rendered.<sup>4</sup> There is a lot of potential for these models to improve people’s lives and reach new heights; however, there are clear risks that make many policymakers and citizens hesitant moving forward.

Deep learning is a subset of machine learning and is generally used in the supervised context; however, can also be applied to unsupervised and reinforcement learning as well. Deep learning describes a family of neural network models that have multiple layers of simple information processing programs, known as neurons in the network. A neural network is a computational model that is inspired by the structure of the human brain. Deep learning has the ability to learn from large amounts of data, which humans cannot handle or comprehend.<sup>5</sup>

A neural network, in terms of deep learning, models complex relationships from the interaction between a large data set of simple neurons. Overall, artificial intelligence is increasing its capabilities in predicting an outcome based on the inputs that the software is given. Most AI systems have a predefined goal that helps the software make a prediction based on the given information.<sup>6</sup> Please view figure 1 below for an illustration that shows the relationship between artificial intelligence, machine learning, and deep learning.

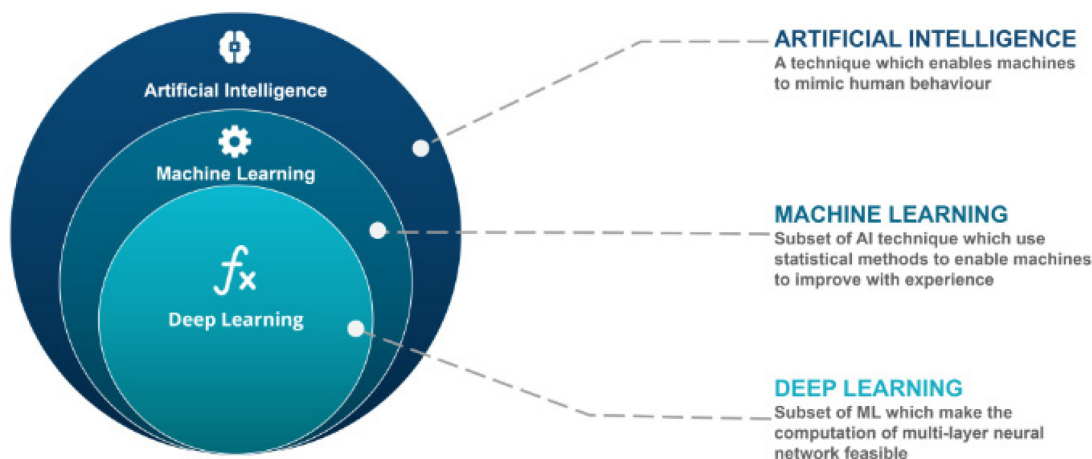


Figure 1. Relationship and differences between artificial intelligence, machine learning, and deep learning.<sup>7</sup>

<sup>3</sup> Benjamin Larsen and Jayant Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. *World Economic Forum*, 2023.

<sup>4</sup> Larsen and Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. *World Economic Forum*, 2023.

<sup>5</sup> Maad Mijwil. “Has the Future Started? The Current Growth of Artificial Intelligence, Machine Learning, and Deep Learning”. *Journal of IJCSM*, 2022.

<sup>6</sup> Agrawal. “Prediction Machines: The Simple Economics of Artificial Intelligence”.

<sup>7</sup> Mijwil. “Has the Future Started? The Current Growth of Artificial Intelligence, Machine Learning, and Deep Learning”.

There are also different types of neural network classifications based on output. Some of these classifications include shallow neural networks, multilayer perception (deep neural networks), convolutional neural networks (CNNs), and recurrent neural networks to name a few.<sup>8</sup> What distinguishes these neural network models is the output and they will continue to get more complex and will be applied in different domains.

**Artificial Intelligence Policy: AI policy is the law, spending programs, standards, and guidance from countries, governments, organizations, and agencies who outline how artificial intelligence should be employed within their jurisdiction.**

AI Policy is the governance of artificial intelligence. It should be a societal effort to channel AI in the best public interest. Some stakeholders in AI Policy include industry, academia, the government, and media.<sup>9</sup> However, there is much more to AI Policy than a societal effort to channel the best public interest through artificial intelligence. AI policy is a combination of tools that the government has that facilitates growth in the field of artificial intelligence. These tools include funding, research and development, legal frameworks, and national security strategies. Additionally, AI policy relates to how governments and defense organizations procure and support the private sector to spark innovation. AI policy also encapsulates the other end of the spectrum – regulation of artificial intelligence in the private sector. Lastly, there are significant international effects that stem from AI Policy decisions among nations.

Different countries and organizations have contrasting philosophies on what type of AI policy will channel the best public interest. Some countries favor stricter laws and regulations on artificial intelligence to control the progress of AI in order to better protect their citizens. Other countries and organizations are more concerned with AI innovation and do not regulate advancements in artificial intelligence at the scale of other nations to let it grow. For both spectrums, governing bodies must emplace AI policy to outline how they want to address Artificial intelligence within their jurisdiction.

**AI Innovation: AI innovation is the introduction and production of new artificial intelligence that increases the capabilities of both artificial intelligence and humans.**

The Tortoise AI index is an index to measure AI capabilities. Some of the metrics that the Tortoise AI index uses include talent, infrastructure, operating environment, research, development, government strategy and commercial.<sup>10</sup> The Tortoise Index ranks countries based on how well they score on the metrics in the index. Currently, the United States leads the world in AI capabilities, while China and the United Kingdom trail behind in second and third respectively.<sup>11</sup>

One of the metrics used in the Tortoise Index is talent. Talent focuses on the availability of skilled practitioners for the provision of artificial intelligence solutions. The indicators with the highest weight that measure talent include, number of artificial meetup groups in the three largest

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<sup>8</sup> Priya Pedamkar. "Classification of Neural Network". EDUCABA, 2023.

<sup>9</sup> Ryan Calo. "Artificial Intelligence Policy: A Primer and Roadmap". 51 U.C.D. L. Rev, 2018.

<sup>10</sup> "The Global AI Index". *Tortoise*, 2022.

<sup>11</sup> "The Global AI Index", 2022.

cities in a given country, proportion of the total of AI engineers on LinkedIn from a given country, and existing number of data scientists in a given country. Each of the metrics have many indicators that produce a score for each country in terms of AI capability.<sup>12</sup>

Additionally, The Stanford Artificial Intelligence Index measures capabilities of artificial intelligence in various subfields, that include including computer vision, language, speech, concept learning and theorem proving. It is important to look at several indexes that measure AI capabilities in order to avoid bias from one of the indexes.<sup>13</sup>

**Ethical AI: Ethical AI encompasses the values and principles that guide our societies to achieve fair use of artificial intelligence in order to protect international human rights, safety, security, and privacy.**

The Berkman Klein center at Harvard has identified that ethical AI encompasses fairness, justice, freedom, non-discrimination, safety, and security. AI needs to promote international human rights in the process of innovation. It takes a combined effort from the government, civil society, private sector, stakeholders, and inter-governmental organizations to promote these values in our society.<sup>14</sup>

Also, the OECD has established principles for the use of artificial intelligence. OECD principles state that AI should benefit people and the planet by driving inclusive growth, AI must function in a robust, secure, and safe way, and that organizations and individual developing AI systems should be held accountable for their proper functioning.<sup>15</sup> Governments can facilitate public and private investment in research and development to spur innovation and trustworthy AI and can ensure a policy environment that will open the way to deployment of trustworthy AI systems.

Additionally, UNESCO has adopted a standard on ethical of artificial intelligence in its effort to establish a global standard-setting ethical framework in the field of AI.<sup>16</sup> UNESCO's recommendations stress data protection, bans the use of AI systems for social scoring and mass surveillance, and helps countries assess the impact of AI systems on individuals.<sup>17</sup> It is important to note that many institutions and organizations already have dozens documents on AI principles and ethics. There is not one "accepted" document; however, there are clear similarities with them all that call for a governing body to regulate AI to ensure it protects the safety of citizens.

## Artificial Intelligence Policy

There are three components that make up AI policy for governing bodies. These three components include objectives, tools, and tradeoffs. There are many different viewpoints on how a government should address these components and is what makes AI policy dynamic between governing bodies. Additionally, with the fast-moving pace of AI innovation, governments are

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<sup>12</sup> Ibid.

<sup>13</sup> "Artificial Intelligence Index Report, 2021 – Chapter 4: Education". *Stanford*, 2022.

<sup>14</sup> Nele Achten. "Principled Artificial Intelligence: Mapping Consensus in Ethical and Rights-Based Approaches to Principles for AI". *The Harvard Berkman Klein Center*, 2020.

<sup>15</sup> "OECD AI Principles". *OECD*, 2021.

<sup>16</sup> "UNESCO adopts first global standard on the ethics of artificial intelligence". *UNESCO*, 2021.

<sup>17</sup> "UNESCO adopts first global standard on the ethics of artificial intelligence". 2021.

constantly having to address or change their strategy regarding these three components of AI policy. Many countries have the same goals when it comes to AI policy; however, each country has different viewpoints on how to reach those goals. The interaction of objectives, tools, and tradeoff analysis is essential when countries develop their AI policy. The sections below will mainly focus on how the United States, China, and the European Union deploy these three components because their laws have the biggest effects on the global AI policy landscape.

## Objectives in AI Policy

There are three main objectives that AI policy addresses. These three objectives include AI growth and capabilities, ethical AI, and international cooperation and sovereignty. Governing bodies have differing outlooks on how they address these three objectives; however, all three objectives are outlined as a part of most country's AI policies. The United States addressed these three objectives in their National Artificial Intelligence Initiative Act (NAIIA)<sup>18</sup> in 2021 and most recently the CHIPS Act in 2022.<sup>19</sup>

### Objective 1: AI Growth and Capabilities

There are many tools available to policy makers that can facilitate the growth of artificial intelligence. One of the most common ways to spark growth in the field of artificial intelligence is to promote AI in educational institutions. Countries can develop grants and funding for educational institutions to grow and develop AI. Governments can also make similar growth and capabilities policies for private and public sector organizations through grants and funding, relaxed regulations and rules, and clustered hub innovation.

There are many processes and laws that the government enforces to enhance the capabilities of artificial intelligence in the private sector, public sector, and academia. The United States market driven private sector allows for emerging technologies to flourish and develop. However, with the creation of the CHIPS Act in 2022, the U.S. government has seen the need to create more innovation hubs that integrate the public, private and academic sectors in central locations. The U.S. government can also procure technology from the private sector to help deliver capital for more AI growth and innovation to take place. The government also has the ability to enhance AI capabilities in the United States through Federally Funded Research and Development Centers (FFRDCs). FFRDCs conduct research and development related activities in support of a federal agency's mission and can specialize in specific technology sectors.<sup>20</sup> Some examples include the MIT Lincoln Laboratory, Los Alamos National Laboratory, and Lawrence Berkely National Laboratory.

### Objective 2: Ethical AI and Protecting Citizens

The regulations and rules enforced by the government play an essential role in the development of AI. The main purpose of regulating AI is to ensure that AI systems and the deployment of AI are ethical and benefit citizens. The U.S. cannot have AI systems that are biased and

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<sup>18</sup> "National Artificial Intelligence Initiative (NAIIA)". *The White House*, 2021.

<sup>19</sup> "Chips and Science Act of 2022". *U.S. Congress*, 2022.

<sup>20</sup> "Federally Funded Research and Development Centers (FFRDCs): Background and Issues for Congress". *Congressional Research Service*, 2020.

discriminatory. The U.S. has a Subcommittee on AI that facilitates the ethical use of AI in the U.S. The Subcommittee on AI advises the president on explainability of AI systems, bias, transparency, security of data, and law enforcement.<sup>21</sup> The subcommittee was created by the White House to help ensure that threshold for human privacy and rights were met in the field of AI. The main goal of the Subcommittee on AI is to ensure that AI is consistent with privacy rights, civil rights and civil liberties, and disability rights.<sup>22</sup> Other countries have stricter laws to regulate AI to ensure the ethical use of AI as opposed to a more voluntary system like the United States.

### Objective 3: International Cooperation and Sovereignty

The effects of one country's AI policy may have significant implications on the world. Europe's General Data Protection Regulation (GDPR) is perhaps the strictest privacy and security law in the world that has major international implications.<sup>23</sup> The GDPR is a great example of a policy on technology that has major implications on other countries like the United States and China. Countries want to cooperate with allies and may want to use AI policy to gain an advantage or disadvantage against their competitors. Additionally, countries want to shape their AI policy, so they have sovereignty, especially from other countries.

The policy that the U.S. decides to develop and enforce has major international implications. For example, If the United States decides to not outsource many of its AI components, such as hardware, software, etc., then countries in east Asia would face backlash from the drop in products bought. If the United States decided to regulate AI more like the European Union, then other countries that develop AI systems for the U.S. would have to abide by stricter laws. As stated above, the EU's GDPR is now one of the strictest privacy and security laws in the world.<sup>24</sup> The GDPR imposes obligations and regulations on organizations that collect data on citizens in the EU and fines the organizations if they do not comply with the EU's data privacy standards.<sup>25</sup> The goal of the GDPR is to protect the privacy and safety of EU citizens from companies through extensive regulatory measures.

One of the most important parts of this legislation is that the GDPR does not only apply to EU companies and organizations, but it also applies to any company that collects data on EU citizens. When one influential country or organization like the EU enforces stricter regulations on technology, then foreign companies and governments are forced to either change how they operate in that region or completely withdraw operations in that region to avoid penalties. Hundreds of companies to include U.S. companies have been fined for breaking the regulations outlined in the GDPR.<sup>26</sup> Although the GDPR is not a specific AI policy, it does impact the

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<sup>21</sup> "H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021". *116<sup>th</sup> Congress*, 2020.

<sup>22</sup> "H.R.6395", 2020.

<sup>23</sup> "What is GDPR, the EU's new data protection law?". *The European Commission*, 2023

<sup>24</sup> "What is GDPR, the EU's New Data Protection Law". 2018.

<sup>25</sup> Ibid.

<sup>26</sup> Scott Ikeda. "Spain Hands Google €10 Million GDPR Fine for Violation of "Right To Be Forgotten" Rules". *CPO Magazine*, 2022.

development and deployment of artificial intelligence around the world because Europe has a very large and influential market.

To transition from the EU, the United States and China are in competition to develop the best AI systems, and changes in one country's policy affects other countries. For example, if one country is accelerating their AI development in their military, the other country is likely to respond with similar policies to enhance their AI systems. Additionally, if a country blacklists procurement of artificial intelligence or specific technologies from a region or a country, then the AI market would shift to more open markets. AI is emerging as one of the most important technologies today. A country's AI policy can have significant implications on AI development and deployment domestically and abroad.

In the following chapters, we discuss how most countries address these three components of AI policy. The United States has stated their 6 strategic pillars in their NAIIA act. These pillars include Innovation, Advancing Trustworthy AI, Education and Training, Infrastructure, Applications, and International Cooperation.<sup>27</sup> These six pillars all fall into the three objectives stated above. The EU, China, and many other leading countries address these three components through different AI policy tools to meet their goals.

## Tools for AI Policy

Governing bodies have three significant tools they use to address their objectives in AI policy. The three tools they use to address their objectives include investing, procurement, and regulations. Each country that develops an AI policy uses some tools more than others based on the objectives they want to prioritize. For example, a country that prioritizes AI growth and development might invest more into research and development programs or private sector programs. However, a country that prioritizes ethical use of AI might emplace more rules and regulations to protect their citizens. Many countries strive to balance both AI growth and the ethical use of AI; however, it is a difficult balance to achieve.

### Tool 1: Investing

Governments can play a major role in dictating the direction of artificial intelligence in their countries through investing. One of the most important tools that the United States often uses when investing is research and development. The United States enacted the National AI Initiative Act of 2020, which sustains consistent support of AI R&D, supports education and workforce training programs, plans, and integrates federal interagency AI initiatives, and supports AI research in education programs.<sup>28</sup> Research and development programs often bolster academic research initiatives, and federally funded organizations (such as FFRDCs). Additionally, the CHIPS Act invests significant funds into the development of artificial intelligence in the form of a clustered hub-based innovation program. The private sector also experiences the benefits of R&D projects by acquiring more knowledgeable students and employees, and using breakthroughs found in the R&D.

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<sup>27</sup> "H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021", 2020.

<sup>28</sup> "H.R.6395", 2020.

Additionally, countries can emplace tax breaks for companies who are developing artificial intelligence. For example, in 2016, the United States government gave an R&D credit of \$250,000 per year for startup companies who are considered AI startups.<sup>29</sup> China invests a little differently in AI. In China, local governments reward companies and entrepreneurs who innovate or develop cutting edge artificial intelligence to promote competition. They are investing at a more local level to drive growth and rewarding companies who do well in the AI space. The United States is starting to move towards a more local level innovation system with the development of the CHIPS Act.

### Tool 2: Procurement

The government can also dictate growth and the direction of AI development by buying AI systems. If governments have the capital to buy systems from the private sector or academia, then companies and universities can use that money to develop more AI. For example, the United States government could buy autonomous drones and vehicles from private sector companies for military use. This niche market would start to flourish because the private sector would be incentivized to build better autonomous drones and vehicles knowing that they have a buyer for their AI systems.

Also, countries have the ability to not buy specific AI systems or technologies for strategic reasons. For example, during President Trump's time in office, he attempted to ban apps and systems that used AI maliciously to obtain data or threaten national security. In 2020, President Trump attempted to ban TikTok and WeChat from the United States due to national security concerns.<sup>30</sup> If major countries like the U.S. strategically decide to ban foreign technology or to not buy foreign AI systems, it can have significant effects on revenue and the foreign development of AI.

### Tool 3: Rules and Regulations

Government can emplace rules and regulations to shape their AI policy in the direction of their best interest. The "best interest" for each country in their AI development differs. If a country wants to enhance AI growth and innovation in their economy, they may make less rules and regulations to allow for that growth. The United States is an example of a country that has fewer binding rules with the private sector regarding AI compared to China and the EU. However, the rules and regulations in China compared to the EU are very different.

Governments can enforce fines and punishments on companies or institutions that do not follow their rules. This would be considered a binding process of rulemaking with the private sector. Europe and China choose to impose fines on companies that break their regulations on AI systems, which is considered to be a binding system of regulation. The United States does not impose fines on the regulatory framework it puts out, rather governing bodies like the

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<sup>29</sup> Charles Goulding et al. "R&D Tax Credits Provide New Opportunities for Artificial Intelligence Start-ups". *R&D Tax Services*, 2016.

<sup>30</sup> Geoffrey Gertz. "Why is the Trump administration banning TikTok and WeChat?". *Brookings*, 2020. *Brookings*, 2020.



Subcommittee on Artificial Intelligence gives guidance and oversight to companies and institutions.

Additionally, in the U.S., NIST has an AI risk management framework that identifies and assesses different risks associated with the deployment of specific AI systems. It is important to note that there are also rules and regulations that can actually stimulate AI growth and innovation as well. China has taken this approach as the PRC attempts to promote businesses and technologies that align with the government and their values.

## Tradeoffs

Tradeoffs influence the tools and objectives that countries prioritize. Some tradeoffs that apply to AI policy include long-standing policy dilemmas like innovation vs consumer protection and attracting talent vs national security, and also more technical tradeoffs like privacy vs accuracy, and explainability vs accuracy in machine learning systems. Innovation, consumer protection, accuracy, etc. are all attributes. A tradeoff is when two attributes (innovation and consumer protection) conflict with each other. It is important to note that there are often more than two attributes in a tradeoff; however, for my analysis in Chapter 2, I will simplify it to two attributes per tradeoff.

Every country would gladly like to maximize all of these attributes; however, with the current state of AI, countries must attempt to balance these tradeoffs and view them as an implicit optimization problem. Governments must choose which attribute to maximize, while meeting a minimum threshold for the other. The following are some major tradeoffs that countries analyze and address when drafting their AI policy. Chapter three includes a more in-depth analysis on each tradeoff and the analysis below is an introduction to the tradeoffs discussed in chapter 2.

### Innovation vs Consumer Protection

One of the most challenging tradeoffs countries face is the tradeoff between innovation and consumer protection. Every country wants to maximize human rights, privacy, and safety through the use of ethical AI to protect their citizens. Every country also wants to maximize innovation and make progress in the field of AI. In order to maximize the ethical use of AI, there would need to be an extensive regulatory framework emplaced with the sole purpose of protecting citizens. However, this extensive regulatory framework would slow innovation in the field of artificial intelligence. The same issue arises if a country creates policies with the sole purpose of facilitating innovation. Consumer protection would be ignored, and ethical issues arise. This balance between innovation and consumer protection is at the forefront of AI policy.



## Talent Attraction vs National Security

One way to enhance innovation for a country is to attract more foreign talent. The government has the ability to create programs for more foreign talented individuals in the field of AI to come to their country; however, the talent attraction can come at a price. With more foreign citizens bringing knowledge to academic institutions and private sector companies, innovation in the field of AI is accelerated. However, there is a higher national security risk of foreign threats when a country incentivizes more foreign individuals to access sensitive information.

## Innovation vs National Security

As more countries push for greater innovation in the field of artificial intelligence, it is clear that a larger pool of talented computer scientists and individuals familiar with AI helps to drive innovation. One of the ways to increase the pool of talented individuals in the field of AI for a given country is to attract foreign citizens who have extensive experience in the field of artificial intelligence. With the increased pool of talented foreign citizens, more innovation is possible due to the new ideas and increased number of people who understand artificial intelligence.

However, when this occurs, national security becomes a larger issue. When a country has more foreign individuals developing domestic technologies, there is a greater threat for national security to be compromised. It would be much easier for foreign countries to attempt to breach domestic national security measures when there are more foreign citizens encouraged to develop technology. Country's need to attempt to balance both a solid national security plan, and a strategy to attract more foreign talent to increase innovation.

## Explainability vs Accuracy

Learning techniques such as neural nets and stochastic models like support vector machines (SVMs) are becoming highly accurate at making predictions.<sup>31</sup> SVMs are machine learning algorithms used in regression analysis and classification tasks.<sup>32</sup> However, with the emergence of some of these accurate models, it is difficult for humans to comprehend how the system came its conclusion. With a lot of the more advanced machine learning and deep learning models, there are increasing dimensions of data that make it more difficult to explain an algorithm's output. Additionally, the more complex models are non-linear in nature which also makes it more difficult to understand an algorithm's output.

This tradeoff is critical because as the field of artificial intelligence progresses, AI systems will become more complex and harder to interpret the decision-making process. Ethical issues can arise when humans cannot explain why a system made the decision it did.<sup>33</sup> Governments want their AI systems to be accurate and make the best possible predictions; however, it becomes clear that accuracy comes at a price.

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<sup>31</sup> David Gunning and David Aha. "DARPA's Explainable Artificial Intelligence Program". *Association for the Advancement of Artificial Intelligence*, 2019.

<sup>32</sup> David Gunning and David Aha. "DARPA's Explainable Artificial Intelligence Program". 2019.

<sup>33</sup> Sendhil Mullainathan et al. "An Economic Perspective on Algorithmic Fairness." *AEA Papers and Proceedings*, 110: 91- 95. 2020.

### Fairness vs Accuracy

Similar to the explainability vs accuracy tradeoff, increased accuracy comes at a price and can create unfairness in a decision. The decision an AI systems makes is only as good as the data it is trained on. There is plenty of existing data that is biased and discriminatory that AI models are trained on.<sup>34</sup> It is important for computer scientists and policy makers to be on the same page and understand this issue when training and employing models. Some common examples of this tradeoff occur in the college admissions process and law enforcement decisions in court. With that being said, there is an increasing amount of research that is showing accuracy and fairness can actually both be achieved in machine learning.<sup>35</sup>

### Privacy vs Fairness

Privacy vs fairness can be a significant tradeoff in AI policy. This tradeoff is not as apparent as innovation vs consumer protection or accuracy vs explainability; however, it needs to be addressed in AI policy because increased privacy occurs at the cost of fairness. An increase in privacy will directly lead to a more unfair output in machine learning algorithms. Research has shown that as more privacy constraints are introduced to an algorithm, such as the addition of random noise, the output can be unfair. The same is true for fairness constraints. In order to make models fairer, AI systems need more data to make fairer decisions. With more data, more privacy violations can occur. This tradeoff is an emerging tradeoff, as artificial intelligence has shown that privacy and fairness need to be addressed in AI policies.

### Privacy vs Accuracy

The privacy vs accuracy tradeoff is an issue that is at the forefront of AI policy and technology in general. The European Union has gone to great lengths to emphasize privacy through their GDPR legislation. Other countries like the United States have not gone to the lengths that the EU has gone to protect privacy because of the decreased accuracy and innovation that takes place when regulatory measures are emplaced to increase privacy. This tradeoff will continue to be at the forefront of AI policy as artificial intelligence systems need more data to make better and more accurate decisions. However, with this increased amount of data, privacy becomes a major issue. Differential privacy is emerging as one technique that is attempting to address this tradeoff and, in the future, will be a critical component of protecting privacy of citizens and facilitating innovation in the field of artificial intelligence.

### Redlines and Non-negotiables

It is important to note that many countries have certain “red lines” or non-negotiables that cannot be broken in the course of AI deployment. In the United States, AI systems cannot be discriminatory based on race, gender, or ethnicity. The United States will not sacrifice civil rights for any type of AI innovation. The U.S. among most other countries will not tolerate any system to be racist, sexist, or discriminatory in any form. This is an example of a red line in the United States and many other countries around the world. When policies makers evaluate

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<sup>34</sup> Ashesh Rambachan, Jon Kleinberg, Jens Ludwig, and Sendhil Mullainathan. "An Economic Perspective on Algorithmic Fairness." *AEA Papers and Proceedings*, 2020.

<sup>35</sup> Michael Wick and Tristan Jean-Baptiste. "Unlocking Fairness: a Trade-off Revisited". *Conference on Neural Information Processing Systems*, 2019.

tradeoffs in their AI policy decisions, a baseline level of ethics should be explicitly set and be non-negotiable.

## History of Artificial Intelligence – Where we have been, where we are now, and where we are heading.

The term, artificial intelligence was officially coined in 1956 at the eight-week long Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI).<sup>36</sup> The roots of artificial intelligence started in the United States in the 1940s from engineers Gregory Powell and Mike Navon. These two engineers developed a story about the “Three Laws of Robotics” that spurred interest in the field of AI.<sup>37</sup> In the 1950s, Allen Turing made an important contribution to the field of AI through his “Turing Test”. Today, the Turing Test is still considered the benchmark to identify intelligence of an artificial system. Turing’s conclusion was that if a human is interacting with machine and the human is unable to distinguish the machine from the human, then the machine is said to be intelligent as it displays humanlike qualities.<sup>38</sup>

### Artificial Intelligence Policy Today

At the time of Turing’s work, people could only imagine that an intelligent system could possibly replicate the intelligence of a human. Today, there are artificial intelligence systems that can pass the Turing test. Some of these systems can be classified as foundation models, or general-purpose artificial intelligence systems (GPAIS). These AI systems are relying on billions of parameters that allow the outputs of the model to be incredibly intelligent and are sometimes unclear to humans how the model came to the result it did. For more on foundation models and how they are changing the landscape of artificial intelligence, refer to chapter 5.

Starting in 2017, countries around the world started to develop artificial intelligence policies and strategies to enhance innovation in artificial intelligence and to regulate the negative effects of AI. Canada was the first to develop an AI policy in 2017, and many countries followed suit after to develop their own AI policies.<sup>39</sup> By late 2022 over 60 countries have published artificial intelligence policies and AI is becoming critical to country’s strategy moving forward.<sup>40</sup> The United States and China are investing hundreds of billions of dollars towards improving artificial intelligence and countries around the world are starting to understand how critical AI is to their economy and national security.

In 2017, China developed an AI policy called, “New Generation Artificial Intelligence Development Plan” with the aim of emerging as the country with the most AI capabilities by 2030.<sup>41</sup> China laid out a roadmap for their country to emerge as the world’s leading power in the field of artificial intelligence with benchmarks at the years 2020 and 2025. China was one of the

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<sup>36</sup> Michael Haenlein and Andreas Kaplan. “A Brief History of Artificial Intelligence: On the Past, Present, and Future of Artificial Intelligence”. *Sage Journals*, 2019.

<sup>37</sup> Haenlein and Kaplan, 2019.

<sup>38</sup> Ibid.

<sup>39</sup> “The Pan-Canadian AI Strategy”. *CIFAR*, 2017.

<sup>40</sup> “The Global AI Index”, *Tortoise*.

<sup>41</sup> “New Generational Artificial Intelligence Development Plan (Stanford Translation)” *The People’s Republic of China (Stanford Translated Edition)*, 2017.

first movers in the AI policy space as they were the second country (after Canada) to develop a national AI strategy in 2017.

The United States has been playing catch-up in terms of AI policy and did not draft an AI policy until 2019. The U.S. had a two-year delay to organize national efforts to innovate in the field of artificial intelligence. Recent legislations like the CHIPS Act among other AI policy legislations has propelled U.S. innovation in the field of artificial intelligence as the United States now has a more concrete AI policy strategy.

The United States currently leads the world in AI capabilities; however, China is quickly catching the United States in capabilities.<sup>42</sup> Some companies developing the most advanced AI systems include Google, The Beijing Academy of Artificial Intelligence, OpenAI, Nvidia, Huawei, IBM, Amazon, Meta, and a few other tech giants. In 2017, there were three main players dictating the growth and innovation of artificial intelligence: The United States, China, and Europe; however, as of late, the United States and China has pulled away from Europe.<sup>43</sup>

The United States and China have emerged as the two front runners leading innovation as we move into 2023. The European Union has fallen behind in terms of AI capabilities and innovation as they focus more on regulation. The European parliament acknowledges their recent shortcomings in the field of AI, and stated in March of 2022 in an annual AI report, “The EU has fallen behind in AI development, research and investment and needs to step up its game as AI is key for the EU's digital transformation and will continue to have an ever-growing impact on the economy and day-to-day life”.<sup>44</sup>

Over the past five years, AI has significantly evolved and is playing a major role in citizen's everyday life in developed countries. AI is now extensively used in fields like finance, healthcare, the military, criminal justice, transportation, smart, cities, and education. AI is transforming our world and it is becoming clear that the country that has the best AI capabilities, will have the best economy, medical practices, educational tools, and national security. AI is no longer an abstract concept that may have an impact on society someday. Our society now runs on AI systems and AI affects people's lives every day. Leaders from across the world understand the importance of artificial intelligence.

### AI Policy Moving Forward

Artificial intelligence policies will be critical for a country's success moving forward. Average AI policies will provide a baseline level of regulation and little innovation in AI. Good AI policies will drive innovation and employ ethical AI systems. The best AI policies will position a country to have the best economy, enhance national security through innovative AI technologies, and employ ethical AI systems that protect consumers at a high level. Ethical innovation in artificial intelligence must be at the forefront of AI policies moving forward because it will

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<sup>42</sup> “The Global AI Index”, *Tortoise*.

<sup>43</sup> Mia Hoffman et al. “What is holding back artificial intelligence adoption in Europe? Bruegel Policy Contribution Issue n° 24/21 | November 2021.”. *University of Pittsburgh*, 2021.

<sup>44</sup> “Artificial intelligence in a Digital Age”. *The European Parliament*, 2022.

dictate the trajectory of their country’s economy, education, and military. AI policies will clearly shape the future of technology and economies for decades to come.

## Outline of Work

**Chapter 1 - “American Inspiration”**: Provides a background of how innovation in the United States has occurred in the past and the policies that facilitated that growth (artificial intelligence is not included). “American Inspiration” outlines how the U.S. has been one of the most innovative countries since 1900 and the policies that have contributed to the United States unprecedented growth and innovation. It also gives specific examples regarding how timing matters when the government regulates industry. Chapter 1 also highlights other countries that have been more innovative or just as innovative as the United States and the policies that facilitated their growth. Other countries (like Switzerland, Israel, Germany, and Singapore) have innovated in specific industries like the automobile, fintech, aviation, and other industries better than the U.S. at times. This chapter outlines what these specific countries did to innovate better in their specific sector and how the United States could adopt some foreign policies to enhance some lacking areas in the U.S. economy.

**Chapter 2 – “Global AI Policies”**: Chapter 2 gives an overview of the AI policies around the world. It includes AI policies from fifteen different countries. Chapter 2 highlights the similarities and differences between these countries and how they employ their AI policies. “Global AI Policies” outlines the mission statement, strategy, funding and innovation, regulation and penalties, and foreign policies for each country’s AI policy. These policies were updated in April of 2023.

**Chapter 3 – “Tradeoffs in AI Policy”**: Chapter 3 analyzes the tradeoffs in the AI policy space and also takes an in-depth analysis of specific countries and their tradeoff analysis in AI policy. The tradeoffs outlined in chapter 3 include explainability vs accuracy, fairness vs accuracy, privacy vs accuracy, privacy vs fairness, innovation vs consumer protection, attracting national talent, vs national security, and innovation vs national security. This chapter addresses these tradeoffs and highlights some of the implicit optimization problems for each tradeoff. Lastly, chapter 3 ends with some potential solutions moving forward to address these tradeoffs in the AI policy space.

**Chapter 4 – “AI Design Choices”** Chapter 4 highlights the features of AI policy and how countries view and incorporate different design choices into their AI policy frameworks. These design choices include government funding, innovation, the binding of laws (voluntary and non-voluntary), the scope of laws (horizontally and vertically), the specificity of laws, education, ethical baselines, military innovation, regulation type, government-private sector trust, and priorities. At the end of Chapter 4, there is a large table that outlines the design features for all of the countries included in this thesis.

**Chapter 5 – “Generative AI and Foundation Models”** Chapter 5 conducts an analysis on the most recent developments of artificial intelligence – generative AI. This chapter goes into depth on the emergence of generative AI models like ChatGPT, DALL-E, Stability Diffusion GPT-3, Wu Dao 2.0, Bert, PaLM, PanGu Alpha, and OPT – also referred to as foundation models.

Foundation models serve as a strong basis for creating generative AI. After an overview of all of the foundation models, Chapter 5 outlines how foundation models and generative AI have significant impacts on U.S. strategic importance, the economic AI supply chain, political and geo-political implications, and military readiness. Lastly, it goes into how the U.S. should approach the development of foundation models moving forward.

**Chapter 6 – “The Artificial Intelligence Startup, Innovation, Defense, Industry, and Academia Act (AI STIDIA Act):** The last chapter to conclude this work is a proposed bill to the United States Congress. This Bill highlights how the United States should innovate in the field of artificial intelligence in an ethical way moving forward. With China catching the United States in AI capabilities, the United States needs a better framework to maintain its dominance in the field of AI. The key areas of focus in the bill include innovation in the fields of foundation models, human machine interaction, and military autonomous vehicles and unmanned aerial systems. This Bill also highlights how the U.S. can improve the ethical deployment of AI.

**Conclusion:** The conclusion wraps up this work and calls for more ethical U.S. innovation in the field of artificial intelligence. The conclusion emphasizes how the U.S. needs to regulate AI more when we have the technology to effectively regulate artificial intelligence. The timing of regulation is essential – look no further than the seat belt and how regulatory frameworks were introduced to protect drivers and passengers. Let’s not make the same mistakes we have made in history and regulate at the correct time when we have the proper technology to do so.

**Appendix – Generative AI and Foundation Models Continued** The appendix gives a more in-depth analysis of the functionality of transfer learning, generative AI, and foundation models. It gives personal examples of the use of several AI systems and how humans can interact with these evolving models.

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[Chapter 1 Below]



## Chapter 1: American Inspiration

“The United States has never been afraid of a challenge. In times of crisis, it is American innovation and ingenuity that has forged the path to progress and prosperity.”<sup>45</sup>

- Dianna DeGette, Colorado Congressional Representative

### A Look into the Past

According to Britannica’s “Greatest Invention List of All Time”, the United States has developed 156 of the total 321 greatest inventions ever developed.<sup>46</sup> Considering that the United States has existed for only 245 years, it is truly remarkable that this country has developed almost half of the greatest inventions of all time. The United States has supplied the world with some of the most important technologies that have improved the lives of billions of people. The U.S. has developed and innovated electricity, the telephone, cameras, airplanes, computers, and the list goes on.<sup>47</sup> Also, the United States has innovated foreign invented technologies, at many times throughout history better than other countries such as the automobile.<sup>48</sup>

Innovating and developing new technologies is also just as important as inventing the technology itself. Many historians have asked, “Why has the United States innovated emerging technologies at such a high rate in their history?”. Is it their resources? Structure of the government? Laissez-faire practices? Government Funding? Education system? It is most likely that all these factors have contributed to U.S. innovation since the origins of this country in 1776; however, there are many more factors that must be considered when analyzing U.S. innovation.

There were also times when other countries clearly innovated better than U.S. As of late, the United States has seen countries innovate emerging technologies better like China, Switzerland, Singapore, and others. What are other countries doing on a policy level that allowed them to innovate better? What can the U.S. learn from other countries? How can the United States return to dominance in innovative markets? How has the U.S. succeeded in the past, and how can we learn from our past successes and failures?

### The Automobile

In 1885, German entrepreneur Carl Benz invented the first automobile.<sup>49</sup> The Europeans innovated automobiles better than anyone else in the late 1800s and early 1900s with Renault, Fiat, and Rolls Royce leading the way.<sup>50</sup> However, European countries started to regulate the car industry in the early 1900s as many citizens feared that the automobile would displace the horse industry and was a danger to society. One poster from the horse-and-cart lobby in England 1908

<sup>45</sup> Diana DeGette. “Fighting Climate Change”. *The Huffington Post*, 2011.

<sup>46</sup> “Greatest Inventions of All Time” *Britannica*, 2022.

<sup>47</sup> Tom Philbin. “The 100 Greatest Inventions of All Time”. *Kensington Publishing Corporation*, 2005.

<sup>48</sup> Peter Hugill. “Good Roads and the Automobile in the United States 1880-1929”. *Taylor & Francis Ltd.* 1982.

<sup>49</sup> Karl Dipling and Dietrich Kuhlitz. “History of the Automobile”. *Bosch Professional Automotive Information*, 2014.

<sup>50</sup> Dipling and Dietrich, 2014.



stated that on the roads there are “reckless motorists” who “kill your children,” dogs, and chickens, and “fill your house with dust”.<sup>51</sup> Europe even had a law that stated cars could not travel faster than horses. Additionally, in the late 1800s, Great Britain had laws, called red flag laws that prevented cars could not move faster than 4 mph in the country and 2 mph in the city.<sup>52</sup> The United States had similar laws; however, they lifted many of these unnecessary regulation (or Red Flag Laws) that allowed them to innovate in the automobile industry.

### The Ford Company Innovation

The Ford company emerged as the top producing car company in the world by early 1920s.<sup>53</sup> The Ford Model T was released in 1909 and was selling for an average price of \$850.<sup>54</sup> By 1924, the price of the Model T went down to \$250. By the end of the year 1927, the Ford Motor Company developed over 15 million Model T’s and millions of middle-class families now had to opportunity to use the emerging technology.<sup>55</sup> Henry Ford and his company revolutionized the automobile market. The question is, what type of government policies and environment allowed the Ford company to develop this incredible innovation that benefited many citizens in the United States?

It was certainly a combination of things. World War 1 helped the United States industrialize and prepare for a mass production of vehicles.<sup>56</sup> Additionally, Calvin Coolidge and Warren Harding’s policies allowed for Ford to innovate and help the average American citizen. It is clear that some of their policies led to the great depression; however, their Laissez-Faire, deregulation of the automobile market allowed the Ford company to innovate better than any other company in the world.

Europe took a different approach to their car industry after World War 1, and it hurt their innovation. Ford started to assemble Model Ts in Britain and Chrysler also began to assemble in Europe. The American car was exported to Europe in bulk because the consumer in Europe saw American cars as robust, reliable, and cheap.<sup>57</sup> In response, several European countries adopted higher taxes for imports and more regulation. As opposed to innovating more, they taxed and regulated more. This trend has continued even into today with the Europe’s GDPR regulation on American Tech companies. This hurt the European car industry for decades.

Not only did the Model T provide significant value to the American citizen, but it also spurred significant investment in American infrastructure by providing a tax base to support the construction of roads.<sup>58</sup> Before Ford made cars available for the average American citizen, the government had tried to develop road networks; however, they did not have the funds or buy in from the American public.<sup>59</sup> After Ford developed the model T, the government was able to

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<sup>51</sup> Brian Ladd. ““Love and Hate in the Automotive Age”. *University of Chicago Press*, 2008.

<sup>52</sup> “Red Flag – Locomotive Act of 1865”. *Cleaner Ocean Foundations Ltd*, 2020.

<sup>53</sup> Christopher Foster and Ken Purdy. “Ford and the automotive revolution” *Britannica*, 2020.

<sup>54</sup> “Encyclopedia of Detroit”. *Detroit Historical Society*, 2010.

<sup>55</sup> “Encyclopedia of Detroit, 2010.

<sup>56</sup> Foster and Purdy, 2020.

<sup>57</sup> Ibid.

<sup>58</sup> Efosa Ojomo. “The Ford Model T: America was once an emerging market”. *Christianson Institute*, 2016.

<sup>59</sup> Ojomo, 2016.

generate enough revenue from the taxes on gasoline. The American public then benefited from the networks and infrastructure of roads from the taxed gasoline. Ford was a direct contributor to improving the lives of the average American citizen. People moved around more and increased economic activity for communities as the government could build more roads from taxed gasoline.<sup>60</sup>

### The Seat Belt

Wisconsin became the first state to require seat belts in the front seats of cars in all models built after 1962.<sup>61</sup> The United States government then implemented a seat belt law in 1968 for all passengers who used a car that was built after 1968. It seems ridiculous today that seatbelts weren't required before 1968. In the 1950s, there were significant arguments against the use of seatbelts. Some researchers claimed that seatbelts could cause internal injuries, they prevented easy escapes from cars submerged in water, and that the devices frequently failed.<sup>62</sup>

All these claims were disputed with significant research that supported seat belt safety and stated that the United States should make it mandatory for the U.S. government to mandate seatbelts in all cars.<sup>63</sup> It wasn't until the 1990s where people started to wear seatbelts on a regular basis. In the 1980s, only about 14% of people wore seatbelts in the United States.<sup>64</sup> Now, 90 percent of the U.S. population wears seatbelts and thousands of lives are saved every year.<sup>65</sup> The lesson learned from the seatbelt is that there is a time and place for some regulation to help the average citizen.

### The Proper Time for Regulation

As stated above, the United States created the first federal law that mandated all new cars be equipped with shoulder belts in the front seats in 1968.<sup>66</sup> This federal law was proposed as the seat belt evolved into a safety feature that protected people. Nils Bohlin invented the first three-point seat belt in 1959 with the Volvo company.<sup>67</sup> However, before the three-point seat belt was developed, seat belts were inefficient and sometimes even could cause more harm than safety. The original seat belt was designed in the mid-1800s by an English engineer named Sir George Cayley.<sup>68</sup> The design of the first image is illustrated below.

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<sup>60</sup> Ibid.

<sup>61</sup> Erika Janik. "The Surprisingly Controversial History of Seat Belts". *Wisconsin Public Radio*, 2017.

<sup>62</sup> Janik, 2017.

<sup>63</sup> Ibid.

<sup>64</sup> Dave Roos. "When New Seat Belt Laws Drew Fire as a Violation of Personal Freedom". *The History Channel*, 2020

<sup>65</sup> Roos, 2020.

<sup>66</sup> Andrew Sheldon. "A Seat Belt History Timeline". AAA, 2021.

<sup>67</sup> Sheldon, 2021.

<sup>68</sup> Ibid.

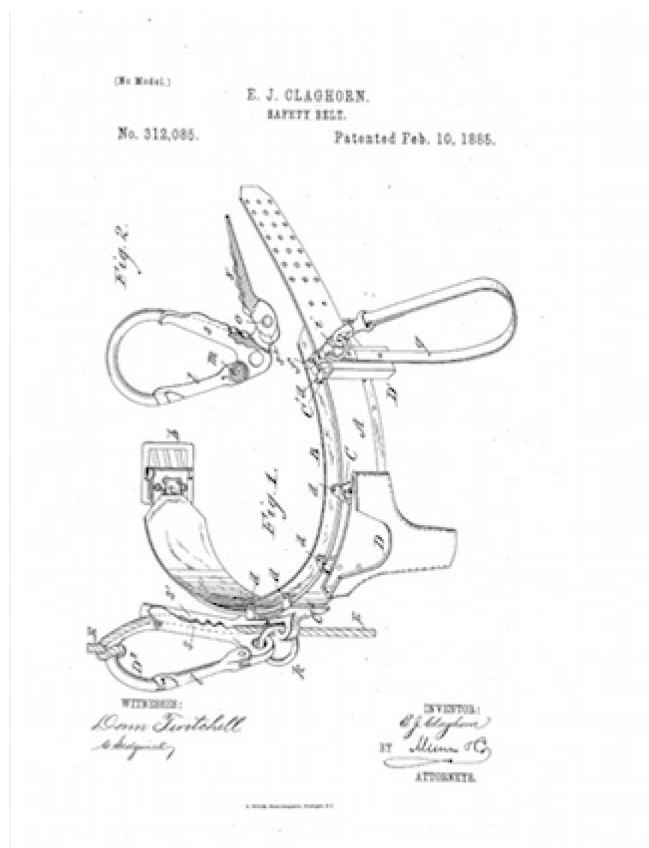


Figure 2. The First Developed Seat Belt<sup>69</sup>

Sir George Cayley's seatbelt was a death trap. The technology used to develop seatbelts was not sufficient to help the driver and put the driver in danger. The seat belt then evolved into a strap that went across the passenger's legs in the 1920s. However, these seat belts were not efficient and sometimes not safe. These seatbelts built before Nils's three-point invention frequently had a failing buckle system and did not significantly protect the passenger.<sup>70</sup> Other than the daily struggle to deal with seat belts that failed to secure or reopen when the passenger wanted to get out of the car, these seat belts were dangerous when cars stopped and could cause significant damage to a driver's neck and waste.

The lesson learned from the seat belt is that the timing of the regulation is important. If the U.S. government mandated that cars must have seatbelts before Nils's invention, it would have done more harm to passengers than good. The timing of regulatory frameworks are essential. The government cannot emplace regulations on emerging markets (like the auto industry) before there is proper technology to assist in the regulation. This is an important lesson that can be applied to many technologies today as well. Better technology helps the regulatory process;

<sup>69</sup> Ibid.

<sup>70</sup> Tushar Mehta. "What Was the First Car to Use Seat Belts?" *Slash Gear*, 2021

however, before the technology is there to help the people, the government could be doing more harm than good with their regulatory frameworks.

## Apollo 11 Program

### The Government's Response to Foreign Innovation

The Soviet Union's Sputnik 1 was launched on October 4<sup>th</sup>, 1957, from a site near Kazakhstan, which shocked the United States and threw them into a frenzy of fear.<sup>71</sup> The United States was leading the world in innovation; however, our contested enemy during the cold war, the Soviet Union, started to gain the upper hand in the late 1950s and early 1960s. The Soviet Union put the first human in space, the first spacewalk, and the first lunar rover.<sup>72</sup> The only thing left to do for the Soviet Union was to put a man on the moon and it would show complete dominance over the United States in the space race.



Figure 3. New York Times Newspaper After the Soviet Union Launched the Sputnik into Orbit.<sup>73</sup>

The United States was in a panic. At the time of the launch of the Sputnik, Lyndon B. Johnson stated, “Now, somehow, in some new way, the sky seemed almost alien... now realizing that it might be possible for another nation to achieve technological superiority over this great country of ours”.<sup>74</sup> This is how many Americans felt. The United States knew they had to respond to Soviet Innovation and technology. But how? Were they going to rely on the private sector like they had previously done with Ford? Or were they going to need to intervene?

When president John F. Kennedy was elected into office, he stated, “this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth”.<sup>75</sup> President Kennedy listened to the former president’s desires

<sup>71</sup> Kate Castell. “Sputnik: The Satellite That Inspired Generations”. *The New York Times*, 2003

<sup>72</sup> Asif Siddiqi. “Why the Soviets Lost the Moon Race”. *Smithsonian Magazine*, 2019.

<sup>73</sup> Castell, 2003.

<sup>74</sup> Ibid.

<sup>75</sup> Monika Gisler and Didier Sornette. “Exuberant Innovations: The Apollo Program”. *Springer Science*, 2008.

and created the Apollo program in the early 1960s to put a man on the moon.<sup>76</sup> Through NASA, the Apollo Program invested about \$25 Billion (\$260 Billion today) into space exploration with the goal of putting a man onto the moon.<sup>77</sup>

In 1963, the federal government acquired 140,000 acres on Merritt Island, just off the coast of Cape Canaveral, FL.<sup>78</sup> The government brought the brightest engineers and best resources to Cape Canaveral. On July 16<sup>th</sup>, 1969, Apollo 11 launched from Cape Kennedy carrying Neil Armstrong and Buzz Aldrin to the moon.<sup>79</sup> An estimated 650 million people watched Armstrong and Aldrin land on the moon that day.<sup>80</sup> Aldrin stated when he returned, “one small step for a man, one giant leap for mankind”.<sup>81</sup> The United States then emerged as the technological leaders in space and the Soviet Union’s space race crumbled to pieces after the Americans put the first person on the moon.<sup>82</sup>

Although the space project’s main goal was to put American men on the moon, Apollo 11 sparked innovation for decades to come in the United States. Technologies such as solar panels, heart monitors, treatments for dialysis, firefighting suits, and many other technologies emerged from the innovation that took place from the Apollo program.<sup>83</sup> The United States saw an increase in STEM education enrollment, strengthening of science and technology reforms in the United States and an increased economic output.<sup>84</sup> A lot of evidence supports this to include British astronomer Brian Cox who points out that for every dollar spent on space exploration in the 1960s, there has been at least a \$7 to \$40 return.<sup>85</sup> The benefits from the Apollo Program are clear; however, can the lessons learned from this apply to the United States today?

### When the Government Needs to Step in to Spark Innovation

The Apollo 11 program is a great example of how the government can spur innovation in the United States, not only for its specific purpose, but for other unforeseen technologies to follow. The United States realized that the private sector alone could not have gotten U.S. astronauts to the moon. The Apollo program, DARPA, and the National Science Foundation are examples of programs that generated and still continue to generate innovation in the United States in areas where the private sector would have not likely taken the risk.<sup>86</sup>

The key takeaway from the Apollo program is that the United States government stepped up and developed important technologies when the U.S. was in competition with another country. The

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<sup>76</sup> Gisler and Sornette, 2008.

<sup>77</sup> Ibid.

<sup>78</sup> Catherine Zuckerman. “Why the Apollo missions made Florida synonymous with space”. *National Geographic*, 2019.

<sup>79</sup> “Apollo 11 Mission Overview”. NASA, 2020

<sup>80</sup> “Apollo 11 Mission Overview”. 2020.

<sup>81</sup> Ibid.

<sup>82</sup> Siddiq, 2019.

<sup>83</sup> “Benefits from Apollo: Giant Leaps in Technology” Lyndon B. Johnson Space Center, 2004.

<sup>84</sup> Erika Carlson. “Apollo boosted the economy, just not the way you think”. *Astronomy*, 2019.

<sup>85</sup> Paul McFarlane. “Celebrating benefits of Apollo program on 50th anniversary of Moon landing”. *Nevada Today*, 2019

<sup>86</sup> Jonathan Gruber and Simon Johnson. “Jump-Starting America”. *Public Affairs – Hachette Book Group*, 2019. New York.

Soviet Union posed a great threat to U.S. national security and fears that the cold war could turn into something more triggered the United States to act. If the United States sees a near peer in the future match or start to overtake U.S. technology, then the government needs to act. The United States passed the CHIPS Act in August of 2022 to combat Chinese influence in the semiconductor industry among other technology industries as well. However, if China starts to innovate and produce better technology in a field like artificial intelligence, then the United States might want to make a similar program to the Apollo 11 program to innovate AI better than anyone else in the world.

## Deregulation of Electricity

Before the 1970s in the United States, the energy sector was regulated, and caused monopolies to develop in the United States. The Public Utility Holding Company Act, passed in 1935, caused three energy companies to own almost half of the utility industry in the United States.<sup>87</sup> Energy prices continued to rise in the 1970s when spikes in oil increased energy costs.<sup>88</sup> In response to the high gas prices, companies started to use and construct power plants that used uranium or coal. These massive construction projects increased the energy prices, and the American people were forced to pay increased prices.

The United States was the first country to develop a deregulatory framework in the electricity market through The Public Utility Regulatory Policies Act (PURPA).<sup>89</sup> PURPA was enacted by President Carter in the 1970s to encourage cogeneration and renewable resources and promote competition for electricity generation.<sup>90</sup> This act promoted the development of organized wholesale electricity markets, federal and state programs encouraging renewable resources, and the adoption of policies at FERC to promote open access transmission policies.<sup>91</sup> This process of deregulating the energy industry created an environment where one company would supply an area. However, people were not forced to use that energy and could use other sources of energy like solar energy.

Over the past few decades, many western countries have taken reforms to deregulate the electricity sector and to allow retail businesses to sell electricity directly to customers.<sup>92</sup> Some common characteristics of deregulating the electricity sector included vertical separation of competitive segments, (generation, marketing and retail supply) from segments that will continue to be regulated (transmission and distribution), the formation of wholesale and retail electricity market opened to the entry of new competitors, the privatization of state-owned utilities, and the establishment of an independent regulator and the implementation of a system of third-party access to the transmission and the distribution system.<sup>93</sup>

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<sup>87</sup> "What is Energy Deregulation?". *Constellation*, 2020.

<sup>88</sup> "What is Energy Deregulation?". 2020.

<sup>89</sup> Marriana Marino, Piepaolo Parrotta, and Giacomomo Valletta. "Electricity (de)regulation and innovation" *ScienceDirect*, 2019

<sup>90</sup> "The Public Utility Regulatory Policies Act of 1978". *American Public Power Association (APPA)*, 2018.

<sup>91</sup> "The Public Utility Regulatory Policies Act of 1978". 2018.

<sup>92</sup> Giacomo Valletta. "Deregulation and innovation: evidence from the electricity industry". *Open Access Government*, 2017

<sup>93</sup> Marino et al., 2019.



## The Proper Scope for Regulation

PURPA provided an incredible opportunity to spur technological innovation in the United States through the development of non-traditional technologies for producing electricity.<sup>94</sup> It also provided an opportunity for the average American citizen to spend less on energy. The United States started to develop more wind turbines, solar energy, and other non-traditional energy sources better than any other country after PURPA's adoption. PURPA allowed small, startup entrepreneurial firms to enter the electricity market.<sup>95</sup>

The importance of PURPA was that it promoted innovation in the energy sector by deregulating the market. Policy makers understood the scope of the problem and addressed the unnecessary increases in energy production prices. It increased competition and it pushed companies to innovate to increase the competitive gap between them and their rivals. A regulated market would be characterized by vertically integrated firms which leads to monopolies, energy shortages, and infrastructure underinvestment.<sup>96</sup>

Europe fell behind the United States in energy production because they continued to take a regulated approach. As a result, England and Wales started to deregulate electricity at the end of the 1980s; however, the United States had a 10-year jump start and were able to lead in energy production innovation.<sup>97</sup> Overall, the United States was able to innovate better than anyone else because they deregulated the energy market first, increased competition, and allowed the private sector to innovate with the guidance and support from the federal government.

The United States consumer benefited from PURPA's deregulatory framework and newer forms of energy were also produced. During the 1980s, energy and gasoline in the United States significantly decreased. The deregulation of energy in the United States produced lower electricity costs and gas prices in the United States.<sup>98</sup> The figure below illustrates how the American people benefited from a deregulated system after PURPA had time to come into full effect by the mid-1980s.

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<sup>94</sup> "Powering the Past – The Public Utility Regulatory Policies Act". *American History*, 2020

<sup>95</sup> "Powering the Past – The Public Utility Regulatory Policies Act". 2020

<sup>96</sup> Marino et al, 2019.

<sup>97</sup> Ibid.

<sup>98</sup> Paul Joskow. "U.S. Energy Policy During the 1990s". *MIT Economics*, 2001.

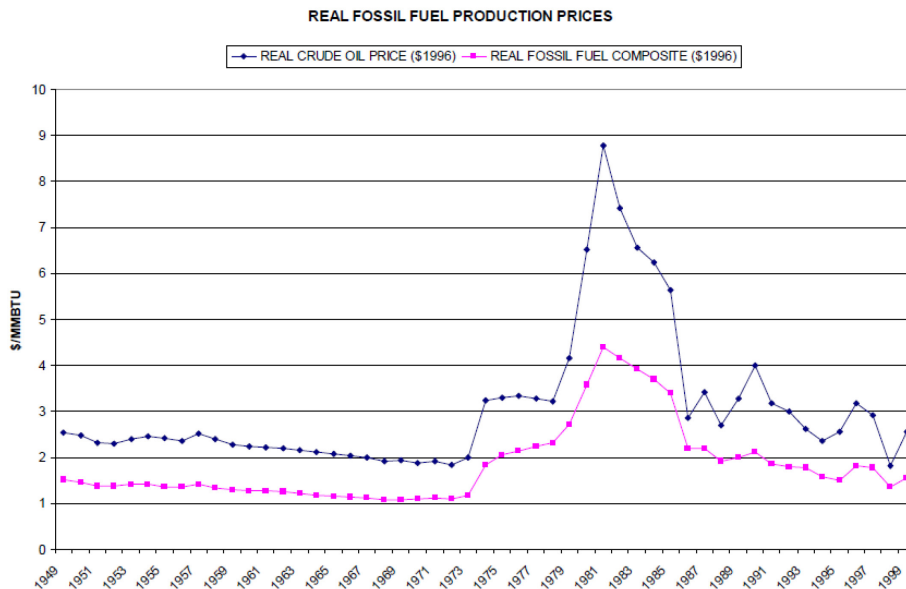


Figure 4. U.S. Real Fossil Fuel Production Rates from 1949 - 1999

Additionally, the United States started to become much more efficient with their use of energy consumed per dollar. The graph below illustrates how the United States was able to make significant progress in energy efficiency after PURPA came into effect compared to the previous regulated market in the 1970s. PURPA has benefited the average American citizens by reducing the price of energy through deregulation since it came into effect.

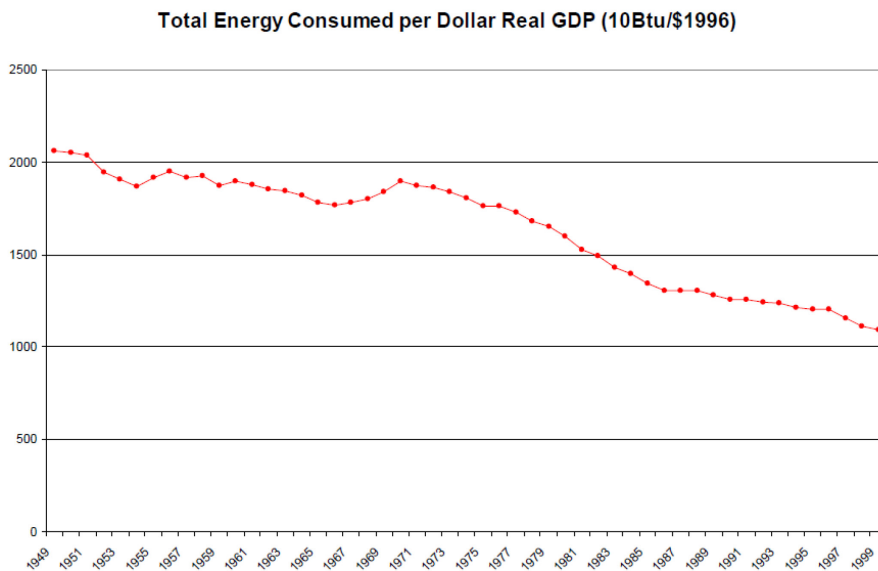


Figure 5. U.S. energy consumption from 1949 - 1999.

As stated above, Europe started to see the benefits the United States people were experiencing, so in the 1990s after England and Wales deregulated their market, Norway, Sweden, and Spain



deregulated their market.<sup>99</sup> Europe started to see reduced prices in energy and innovation in renewable energy spurred in the 1990s.<sup>100</sup>

It is important to note, that the United States was the first movers in the deregulation of the electricity industry and were able to capitalize on innovation in the renewable energy market. As of 2017, PURPA projects accounted for over 40% of the solar energy projects built in the United States (Wiseman, 2020). According to the Solar Power World organization, “PURPA has driven solar development because it obligates utilities to purchase renewable energy from qualified facilities’ (QFs) projects if the cost of energy meets or is less than fossil fuels”.<sup>101</sup> The United States is now one of the leading countries in solar energy production.

## The computer

### The IBM Trial

In 1967, the United States government sued IBM as IBM’s competitors complained that IBM had monopolized the computer market.<sup>102</sup> The government alleged that IBM’s marketing of its System/360 family of mainframe computers excluded peripheral equipment manufacturers from the market by use of similar practices.<sup>103</sup> The anti-trust case of the United States vs IBM was one of the most disastrous court cases in U.S. history and is a great example of how the government can misjudge a monopoly.

This court case spanned the terms of five presidents, 87 witnesses, 104,400 trial transcript pages, and 700 trials days. The government spent approximately \$16.8 million over the course of the lawsuit and a total of over \$50 million between the two parties.<sup>104</sup> After fifteen years of deliberation, the United States dropped the court case as it one of the greatest waste of resources in the history of antitrust enforcement occurred. The U.S. government simply squashed IBM during that 15-year period, just to allow another monopoly to replace IBM, Microsoft. Microsoft then emerged as an even greater monopoly soon after IBM was curbed by the government.

There are two important lessons learned here from the U.S. vs IBM antitrust case. First, this case showed that markets usually do work. Market sometimes can work better than the institutions of antitrust serving the interest of the American citizen. There is a time and place for the U.S. to intervene in anti-trust policies; however, they need to be sure that it is helping the average American citizen, and simply not trying to gain more power over the markets.

The second lesson learned from this case is that when the government tries to break up a monopoly through anti-trust, there is often another competitor that will emerge as an even greater monopoly. During the court case, IBM had to devote a significant number of resources to the anti-trust case, instead of innovating and delivering better products to consumers. Microsoft took advantage of the vacuum that occurred in the computer industry and emerged as an even

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<sup>99</sup> Marino et al, 2019.

<sup>100</sup> Ibid.

<sup>101</sup> Marissa Wiseman. “What is PURPA?”. *Transformation*, 2020.

<sup>102</sup> John Lopatka. “United States V. IBM: A Moment of Arrogance”. *Bluebook 21st Ed.*, 2000.

<sup>103</sup> Lopatka, 2000.

<sup>104</sup> Ibid.

larger monopoly. It is important to note that Microsoft did create new technology (operating systems among others) that allowed them to win their market. However, the IBM trail clearly allowed for another tech giant to replace IBM in the market. The government needs to understand the dynamic of the markets better before they intervene and attempt to break up a “monopoly, as anti-trust cases like the U.S. vs IBM show that anti-trust cases often hurt the consumer and the American people more than anyone else.

### The Rise of Microsoft and the PC

In 1975, Bill Gates and Paul Allen developed a computer programming language for use on an early PC.<sup>105</sup> A few years later, these two founded Microsoft and changed the computing world forever. In 1981, IBM introduced its first personal computer, which used Microsoft’s 16-bit operating system MS-DOS.<sup>106</sup> The company started to gain traction in the personal computer world and went public in 1985. In 1985, Microsoft shipped and developed its Windows 1.0 operating system. By 1990, Microsoft had developed and sold 60 million copies of Windows to the world and yielded a revenue of \$1 billion as Microsoft cut ties with IBM following the IBM antitrust lawsuit.<sup>107</sup>

The true winners of this development were the American people and the U.S. government. As IBM lost traction in the computer industry in the 1980s, Microsoft emerged as the leading computing company in the world. Microsoft not only put a PC in every home and on every American desk, but Microsoft was critical in reshaping the relationships between platform providers, developers, businesses, and consumers that are now the foundations of the current age of personal computing.<sup>108</sup> With user friendly tools, Windows made something that was remote and foreign to the American people; however, came to realize the benefits of the PC.<sup>109</sup> PCs eventually started to help people all around the world. They helped authors create bestsellers, musicians write great songs, and artists create masterpieces.

### Apple – Brief History

In 1976, Steve Jobs and Stephen Wozniak founded Apple, and released their first computer, “The Apple 2”.<sup>110</sup> Apple got off to a quicker start than Microsoft. Apple netted over \$100 million in 1980; however, were dethroned by IBM’s PC (which used Microsoft’s DOS) in the mid-1980s.<sup>111</sup> By 1986, there was fierce competition between the IBM and Microsoft duo and Apple. It seemed that these two companies were in competition for decades to develop the best products. Microsoft emerged as the leader of the computing world in the 1990s; however, Apple did not stop innovating.

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<sup>105</sup> Mark Hall. “Microsoft Corporation”. *Britannica*, 2020.

<sup>106</sup> Zacks Research Group. “Apple vs. Microsoft: Evaluating the Two Giants' Growth Since the 1980s” *Nasdaq*, 2018.

<sup>107</sup> Jon Cowling. “A Brief History of Microsoft - The World’s Biggest Software Company”. *DSP*, 2016.

<sup>108</sup> Jason Ward. “How Microsoft's technological and social impacts have changed the world” *Windows Central*, 2020.

<sup>109</sup> Ward, 2020.

<sup>110</sup> Steven Levy. “Apple Inc.” *Britannica*, 2022.

<sup>111</sup> Levy, 2022.

In 2002, the Mac sold over 3 million Macs, and by 2012, they sold over 18 million Macs.<sup>112</sup> By the end of the 2000s, Apple started to surpass windows because they became more innovative and reduced their prices compared to windows.<sup>113</sup> However, the important part of this story is that the American people once again won. Apple developed the best phones in the 2010s and computers in the 2000s, and the American people benefited from it, just like they did from Microsoft in the 1990s.

Apple and Microsoft accelerated the U.S. economy to new heights. By the mid-2000s, the United States dominated technology. No matter the country you resided in, you either bought a windows or a Mac, and not much has changed since then. American companies have dominated this market and have provided incredible value to the American people and the rest of the world. This innovation and dominance are a result of the original policies developed in the 1980s that allowed Apple and Microsoft to emerge as world leaders in computer development.

### The Policies that fueled Microsoft's and Apple's Innovation

There is something truly magnificent about the 1980s and 1990s when it comes to emerging technologies in the United States. The policies from Presidents Ronald Reagan and Bill Clinton facilitated this growth and allowed companies like Microsoft and Apple to emerge as some of the most innovative companies of all time. Although Reagan was a Republican President and Clinton a Democratic President, both Presidents had policies in place to facilitate an environment that allowed the private sector to develop incredible technologies that promoted the U.S. economy and improved the everyday life for the average American.

### The Reagan Approach to Innovation

When President Reagan entered office in 1981, he reduced the size of the government and spending power; however, he increased the federal budget for science programs. His policies called for large increases in R&D in the technology sector and the Department of Defense as well.<sup>114</sup> For companies, Reagan tried to encourage more research by showing economic incentives for companies that innovated in the fields of technology and science. Many believe that Reagan left a legacy of bringing the technology and science private and public sector communities together.<sup>115</sup>

Reagan's economic philosophy, coined "Reaganomics" essentially slashed significant government spending in the national economy, and put more cash into the hands of corporations and individuals.<sup>116</sup> He still supported the technology sector with some R&D programs; however, he gave a lot of money for the private sector to innovate. He also rewarded companies that innovated in the field of technology. This was ideal for innovators like Bill Gates and Steve Jobs,

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<sup>112</sup> "Global Apple Mac sales in the fiscal years from 2002 to 2018". Statista, 2018.

<sup>113</sup> Daniel Dilger. "Apple, Inc. sold more computers than all of Microsoft's Windows PC partners in December quarter". *Apple Insider*, 2014.

<sup>114</sup> David Hanson. "Reagan's R&D Legacy". *Chemical and Engineering News*, 2004.

<sup>115</sup> Hanson, 2004.

<sup>116</sup> Colin Norman. "Is Reaganomics Good for Technology?". *The Journal of Science*, 1981.

and it facilitated an environment that allowed them to develop and grow. In addition, Reagan supported the growth of technology in the military as well alongside the private sector.<sup>117</sup>

Reagan's policies facilitated the original growth of Microsoft and Apple, and without his policies, the innovation these two companies developed in the 1980s could have easily been stalled if regulatory policies were put in place. Reagan built a good environment for Gates and Jobs to succeed. He put the money in the hands of the private sector to let them innovate without much regulation. These two companies then changed the world and benefited all Americans with their products. He additionally provided incentives and rewards for companies who innovated well. The private and public sector had a great relationship together and the United States started to embark on an incredible era of innovation. The United States should use this philosophy more often today to facilitate an environment that promotes more innovation in the field of technology and to bridge the gap of trust between the public and private sector.

### The Clinton Approach to Innovation

Clinton and Reagan had many different economic policies; however, both of their policies facilitated growth and innovation in the technology sector. It was under the Clinton administration, when Microsoft and Apple emerged as the largest companies in the world and provided substantial value to the American people. Instead of not directly investing in the private sector, President Clinton increased R&D funding in the technology private by 43 percent when he came into office.<sup>118</sup> This was a change in approach to Reagan's Laissez-Faire approach; however, they both allowed the technology sector to grow. There were major differences between the Reagan and Clinton administration. One of them was that Clinton wanted to shift the R&D development and funding from the military to the private sector.<sup>119</sup> Although there was a change in the funding approach in the Clinton administration, he and the government still allowed the private sector to innovate with little regulatory frameworks. They did not explicitly regulate these emerging market industries and let them grow.

### Breaking Up Microsoft

Three decades after the IBM antitrust case started, the United States then looked to challenge Microsoft in the 1990s. The Federal Trade Commission then sued Microsoft in the early 1990s for licensing issues, and then sued Microsoft again for violating the Sherman Act in the late 1990s.<sup>120</sup> In the case of STATE OF NEW YORK et al Vs. Microsoft - Attorney General Eliot won the case; however, Microsoft won the appeal to break up their operating systems from their software.<sup>121</sup> The lawsuit kept Microsoft in check and showed that there is a place for anti-trust laws to come into place. However, the United States should use the Sherman Act as a last resort to break up big tech as it stalls innovation on a global scale for the United States and can set precedents for more government control over the market.

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<sup>117</sup> Hanson, 2004.

<sup>118</sup> "The Clinton Presidency: Unleashing the New Economy — Expanding Access to Technology". *The White House*, 2020.

<sup>119</sup> William Broad. "Clinton to Promote High Technology, With Gore in Charge". *The New York Times*. 1992.

<sup>120</sup> Ronald Cass. "Anti-Trust for High-Tech and Low: Regulation, Innovation, and Risk". *Bluebook*, 21st Ed, 2013.

<sup>121</sup> "U.S. V. Microsoft". *The United States Department of Justice*, 2022.

## Lessons Learned From IBM

The government learned its lesson from IBM, and swiftly tried to make the necessary changes to Microsoft and the computer industry. The Microsoft case spanned only 6 years, and each side were limited to 15 witnesses total.<sup>122</sup> The government narrowed its focus on Microsoft and attacked the bundling policies at Microsoft instead of completely trying to regulate the company as it did during the IBM case.<sup>123</sup> The Microsoft case did help the computing market to become a more competitive market; however, it was because the U.S. government sought to swiftly find Microsoft on violating the Sherman Act and allowed Microsoft to continue to innovate instead of completely crippling their company.

Today, many argue that big tech should be regulated and at the mercy of the government's anti-trust laws; however, history tells us that the government should take a different approach. The government and private sector should work together more, especially with academia to facilitate ethical innovation in big tech. The Clinton and Reagan administration both had a good working relationship with the private sector and technology companies outside of the Microsoft and IBM cases. Our country saw an unprecedented growth in technology and the United States paved the way for innovation for the rest of the world to follow. The United States government needs to be careful in antitrust cases moving forward, as government intervention can cause unintended consequences in the market.

## The American Technology Machine

The United States currently has the largest and most innovative technology companies in the world. According to *Forbes*, the United States has 13 of the largest 20 technology companies in the world.<sup>124</sup> This list is led by the trifecta of American tech giants, Apple, Alphabet, and Microsoft. China is clearly catching the U.S. in terms of technological innovation; however, the largest companies are still in the United States. The United States is still reaping the benefits and driving innovation. (View the chart below for the top 10 technology companies in the world in terms of sales and market value).

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<sup>122</sup> Lopatka, 2020.

<sup>123</sup> Ibid.

<sup>124</sup> Jonathan Ponciano. "The World's Largest Tech Companies In 2022: Apple Still Dominates as Brutal Market Selloff Wipes Trillions in Market Value". *Forbes*, 2022.

Rank	Name	Country	Sales	Market Value
1	Apple Inc.	United States	\$378.7 billion	\$2.6 trillion
2	Alphabet Inc.	United States	\$257.5 billion	\$1.6 trillion
3	Microsoft Corporation	United States	\$184.9 billion	\$2.1 trillion
4	Samsung Group	South Korea	\$244.2 billion	\$367.3 billion
5	Tencent Holdings Ltd.	China	\$86.9 billion	\$414.3 billion
6	Meta Platforms	United States	\$117.9 billion	\$499.9 billion
7	Intel Corporation	United States	\$79 billion	\$190.3 billion
8	Taiwan Semiconductor Manufacturing Co.	Taiwan	\$61.5 billion	\$494.6 billion
9	Cisco Systems Inc.	United States	\$51.5 billion	\$213.4 billion
10	IBM	United States	\$67.3 billion	\$124.3 billion

Source: Forbes' Global 2000 2022 • [Get the data](#) • Created with [Datawrapper](#)

Figure 6. Forbes 2022 largest technology companies in the world based on sales and market value<sup>125</sup>

## Apple

American tech giants benefit U.S. citizens every day. Many people argue that tech giants are bad for the American consumer; however, there is clear evidence that the U.S. technology companies significantly improve the lives of American citizens. A study in 2017 found that the average American household owns 2.6 Apple products.<sup>126</sup> That number has most probably grown since then as well. 64 percent of the American public say that their time on their apple products is “most productive and useful”.<sup>127</sup> It is clear that Americans love their Apple products; however, Apple does more for American citizens and people around the world than most people realize.

Apple’s innovation in the fitness sector has helped Americans and people around the world become more aware of their fitness and has helped people live healthier lives. In 2020, Apple came out with Apple Fitness + to give people personal fitness plans during the pandemic.<sup>128</sup> This service has helped many people around the world throughout the pandemic with personal virtual trainers, consistent workouts, and monitored progress.<sup>129</sup> Additionally, Apple’s innovation and breakthroughs in helping people become more fit is inclusive to lower income citizens. The 2017 survey stated that on average, there are at least one Apple product in lower income families.<sup>130</sup> People from all backgrounds are having access to the innovation that occurs Apple.

## Alphabet

Google gives American citizens and people around the world the opportunity to access an incredible amount of information in seconds. However, one overlooked role that Google plays in

<sup>125</sup> Ponciano, 2022.

<sup>126</sup> Steve Liesman. “America loves its Apple. Poll finds that the average household owns more than two Apple products”. *CNBC*, 2017.

<sup>127</sup> Liesman, 2017.

<sup>128</sup> Jack Nicas. “Apple Targets the Fitness Market”. *The New York Times*, 2020.

<sup>129</sup> Venessa Orellana. “Apple Fitness Plus is a no-brainer for Apple Watch users”. *CNET*, 2021.

<sup>130</sup> Liesman, 2017.



American society and Western Europe is in education. Google empowers students and levels the playing field through learning materials, and tools in the classroom.<sup>131</sup> There are more than 40 million teachers, tutors, staff members, and students who utilize Google's products. Google empowers students and gives them a world of opportunities at their fingertips, regardless of their socioeconomic status.

Out of the best 100 American universities, more than 70 are using Google Apps and search engine.<sup>132</sup> Additionally, out of the eight Ivy league colleges in the United States, seven of them use google apps and search engines. Google is an innovative company that helps students, teachers, and faculty around the world to improve their products. Google's market size and reach around the world is one reason why it benefits so many people, especially in the United States.

## IBM

IBM is helping American citizens and people around the world in many untraditional ways. Every year, climate related disasters and natural hazards push 26 million people into poverty.<sup>133</sup> In response, the American technology giant IBM, launched the IBM Sustainability Accelerator to help scale non-profit and government organizations to help vulnerable populations to environmental threats.<sup>134</sup> IBM has launched this social impact program, and it leverages IBM technologies such as hybrid cloud computing, AI, and an ecosystem of experts.

IBM found that Black and African American individuals are projected to face higher climate change than any other demographic. Additionally, they found that LatinX have high participation in weather-exposed industries such as agriculture and construction.<sup>135</sup> IBM has realized this issue and is using their innovative technologies and capital to help the American people, especially disadvantaged Americans. Obviously, IBM has supplied Americans and other countries with state-of-the-art computer hardware, software, and hosting services that have benefits companies and people<sup>136</sup>. However, IBM's Sustainability Accelerator is a great example of U.S. company using its innovative technology and capital to help the American people.

The three examples above (Apple's Fitness enhancer, Google's educational empowerment, and IBM's Sustainability Accelerator) are specific examples illustrating how large American Technology companies are beneficial to American citizens and other people around the world. All American companies on the Forbes 2022 largest technology companies list have supplied the American citizens with incredible technologies that improve their lives. The U.S. government should continue to allow innovation in large technology firms to continue in order to help American citizens in the future. It is clear that innovations that occur from large U.S. technology companies not only bolster the status of large technology company owners but more importantly improve the lives of the average American citizen.

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<sup>131</sup> "The Role of Google In Education". *British Technologies*, 2022.

<sup>132</sup> "The Role of Google In Education", 2022.

<sup>133</sup> Milanesi, Carolina. "IBM's Sustainability Accelerator Program Empowers Governments and Non-Profits To Address Environmental Threats To Vulnerable Populations". *Forbes*, 2022.

<sup>134</sup> Milanesi, 2022.

<sup>135</sup> Ibid.

<sup>136</sup> Ibid.

## The Importance of Large Technology Companies in the United States

Technology is a critical driver of National Security and economic power. A recent report from the Lexington Institute argues that if the technology sector in the United States falters, the U.S. will lose its status as the world's leading economic and military power.<sup>137</sup> In the past, the United States has been able to sustain a culture of innovation through *laissez-faire* policies that stimulated growth in the private sector. However, now countries like China are starting to rival the United States in technology innovation, which poses a national security risk.

The U.S. military and Department of Defense have had to face major military challenges in every generation, and those challenges were often dictated by emerging technologies.<sup>138</sup> However, today the private sector is driving the innovation in emerging technologies such as 5G communications, AI, and microelectronics. The companies on the list above (Google, Microsoft, Apple, etc.) are driving the innovation that is helping the United States in their national security battle.

The U.S. needs to continue to help large technology companies to innovate to not only enhance the lives of American citizens, but to secure national security at a higher level. With a lot of the world using U.S. products (Apple, Google, Microsoft), the U.S. government needs to ensure that the systems within the technology are secure. Additionally, the U.S. should continue to promote these innovative companies and allow for them to improve their technologies with policies that promote innovation.

## A Look into Other Innovative Countries

### The Israeli Hotbed

#### The “Start-Up Nation”

Israel is one of the most innovative countries in the world and has invented an abundance of new technologies in the seven decades it has existed on this planet. Israel has been coined as the “The Startup Nation” because of its incredible entrepreneurship, innovation, and defense capabilities.<sup>139</sup> Many ask, how can a country like Israel, who is constantly at war, under immense political pressure, and have no natural resources produce more start-ups than the United Kingdom, Japan, and Canada?<sup>140</sup>

There are many reasons why Israel is incredible at developing technologies and innovating; however, the main driver for their success is that the government facilitates an incredible environment for innovation, the population of Israel must serve in the military and receive degrees, and it has culture of risk taking.<sup>141</sup>

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<sup>137</sup> Loren Thompson. “Report: A Robust Tech Sector Is Critical To U.S. National Security”. *Forbes*, 2020

<sup>138</sup> Thompson, 2022.

<sup>139</sup> Dan Senor and Saul Singer. “Start Up Nation”. *Twelve*, 2011.

<sup>140</sup> Senor and Singer, 2011.

<sup>141</sup> Mark Broude, Saadet Deger, and Samnouth Sen. “Defense, Innovation and Growth”. *Journal of Innovation and Economics*, 2013.



In a conversation between Information Technology and Innovation Foundation President, Rob Atkinson, and Georgia Tech Professor, Mark Taylor in 2018, these two attempted to pinpoint what made countries like Israel so innovative. In the 1960s, Israel created elite science and technology units in the Military.<sup>142</sup> While new technologies were being developed, private companies were innovating along with the Military. Israeli business leaders would work with the government and create a sense of trust between the public and private sector.<sup>143</sup> Israel has shown us when the private sector and public sector are working together, incredible innovation can occur, regardless of natural resources available and wartime circumstances.

### Israeli Technological Breakthroughs

Israel is one country that certainly has challenged the United States in the technology sector over the past 50 years. In the 1970s, Israel made a significant change to their government structure and private sector innovation. Before the 1970s, Israel's innovation was stalled, and they were more focused on protecting themselves from aggressive countries in their region. However, in the 1970s, Israel transformed from a mixed-socialist capitalist system into a market system.<sup>144</sup> Less government involvement and stronger commercial and international ties facilitated more entrepreneurship and innovation in Israel.<sup>145</sup>

Israel has seen incredible innovation and inventions emerge in their country since the 1970s. Israel invented the firewall (1993), digital printing press (1993), breakthroughs in robotics like Mazor Robotics Spine Assist (2004), and Rewalk (2010), and innovations in the military like the Iron Dome (2011).<sup>146</sup> Every year, TIME Magazine recognizes the top 100 groundbreaking inventions. In 2019, Israel had 9 inventions on the list, 6 in 2020, and 4 in 2021.<sup>147</sup> This small country is achieving incredible breakthroughs in robotics, security, defense, and biotechnology. They are competing with and exceeding the United States in some of these industries. How is this small country competing with the United States and what can we learn from them?

### Learning From Israel

In 2020, according to the World Bank, Israel has the highest research and development expenditure (% of GDP) at 5.54. The United States had an R&D measure at 3.45, South Korea at 4.81, and China at 2.86.<sup>148</sup> Israel spends a larger percentage of R&D than any other country. Israel pairs the R&D investment with targeted programs that boosts basic research and maximizes their economic strengths.<sup>149</sup> The United States should model their R&D model after

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<sup>142</sup> "The Politics of Innovation: Why Some Countries Are Better Than Others at Science and Technology". *Information Technology and Innovation Foundation (ITIF)*, 2018.

<sup>143</sup> "The Politics of Innovation: Why Some Countries Are Better Than Others at Science and Technology", 2018.

<sup>144</sup> Aharon Kellerman. "Conditions for the Development of High-Tech Industry: The Case of Israel". *Blackwell Publishers*, 2001.

<sup>145</sup> Kellerman, 2001.

<sup>146</sup> "Israeli Inventions That Changed the World". *Haaretz Labels*, 2021

<sup>147</sup> Ricky Ben-David. "4 Israeli inventions feature in TIME magazine's 100 Best Inventions for 2021". *The Times of Israel*, 2021.

<sup>148</sup> "Research and development expenditure (% of GDP) - Israel, United States, Belgium, Netherlands, China, Korea, Rep.". *World Bank*, 2022.

<sup>149</sup> Hideki Uno and Benjamin Glanz. "Sustaining Israel's Innovation Economy" *Center for Strategic & International Studies*, 2022.

Israel's in the artificial intelligence sector to spur more innovation and develop better technologies.

An additional contributor to Israel is that all Israeli citizens must serve in the military. All men must serve for at least 32 months and women must serve for at least 24 months unless specific religious or physical reasons exempt them.<sup>150</sup> The Israeli Defense Force (IDF) also takes specific measures to invest in all soldier's education.<sup>151</sup> This also includes immigrants as well. The IDF's Academic Reserve training program invests in high school graduates, enabling them to earn their university degrees in science or technology fields.<sup>152</sup> For example, the Israeli cybersecurity industry makes up of 65% of all financial transactions conducted by software-related startups from 2017 to 2022.<sup>153</sup> The cybersecurity industry in Israel is mostly a byproduct of their military-private sector crossover. By comparison, United States cybersecurity companies only account for 13% of total financial transactions.<sup>154</sup> The United States and other countries should use the lessons from Israel's capitalist economy, strong private-public sector relationship, and culture of entrepreneurship in their pursuit to innovate better technologies.

## Switzerland

Switzerland has historically had one of the most innovative countries in the world due to their economic freedom, elite universities, and existing markets in technology. Switzerland has led the Global Innovation Index from 2011-2020 and is ranked third in the Bloomberg Innovation Indicator in 2021.<sup>155</sup> According to the USIS, Switzerland has the third highest worldwide national R&D expenditure in 2018 and submitted the seventh most patents in 2019 according to IPI.<sup>156</sup> Switzerland most certainly rivals the United States in innovation, and arguably innovates better than the United States in specific sectors like fintech and biotech.<sup>157</sup> Why is Switzerland doing so well? What can the United States learn from their innovation in fintech and biotech and apply it to AI?

There are currently 220 Fintech companies located in Switzerland, and more than 100 of those companies are operating in the crypto and blockchain industry.<sup>158</sup> In 2019, the Swiss biotech market generated 4.8 billion CHF (francs), proving that it is a worldwide hub for the biotech industry. The technology sector does very well in Switzerland because the Swiss economy offers conditions that are business-friendly and encourage innovation.<sup>159</sup> The Swiss government does not extensively regulate intellectual property generated from public sector R&D, unlike their

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<sup>150</sup> Emanuel Fabian. "Knesset delays 2-month reduction in mandatory military service for men". *The Times of Israel*, 2022.

<sup>151</sup> Haenlein and Kaplan, 2019.

<sup>152</sup> Gil Baram and Isaac Ben-Israel. "Israel's Fast Track to High-Tech Success". *Israel Studies Review*, 2019 Vol. 34, Is. 2.

<sup>153</sup> Uno and Glanz, 2022.

<sup>154</sup> Ibid.

<sup>155</sup> "Swiss Innovation Landscape". *JETRO Geneva*, 2021.

<sup>156</sup> "Swiss Innovation Landscape", 2021.

<sup>157</sup> Adnan Pavlovic. "Here's why Switzerland is a world innovation leader". *WeAreDevelopers*, 2020.

<sup>158</sup> Pavlovic, 2021.

<sup>159</sup> Hart Hotz. ""Innovation Switzerland: A particular kind of excellence". *ResearchGate*, 2012

European counterparts.<sup>160</sup> Additionally, Switzerland uses its top universities and other vocational programs to innovate in specific hubs around the country at high levels like Zurich, Geneva, and Lugano.<sup>161</sup>

#### Education, Innovative Private Sector, and Government Support.

There are several factors that have allowed Switzerland to innovate so well in the fintech and biotech fields. These factors include Switzerland's education system, innovative private sector, and effective government support.<sup>162</sup> The United States could implement more policies similar to the Swiss's technology policy to spur more innovation. Switzerland is a small landlocked country in Europe, with limited resources. How is it competing with the United States?

One factor that contributes to success for Swiss tech is that Switzerland has a dual vocational education and training.<sup>163</sup> Two thirds of graduates in Switzerland elect to take this path and it allows students to conduct practice-oriented education and training that is designed to address the most recent technologies and issues in the workplace.<sup>164</sup>

One of the most critical factors that allow for Swiss innovation is the partnership between private sector companies, clients, and university R&D purchases.<sup>165</sup> The Switzerland Innovation Park Zurich Foundation provides an environment that facilitates innovation between companies like Canton of Zurich, the ETH of Zurich, and Zurich Cantonal Bank with universities like the University of Zurich.<sup>166</sup> There are innovation parks in Ost, West EPFL, Basel, and Biel that integrate colleges and private sector tech companies to spur innovation.<sup>167</sup>

One innovation park in particular, Park Ticino, is incredible at innovating and marketing pharmaceuticals, drones, blockchains, and dApps.<sup>168</sup> The United States could learn from the Swiss and implement hubs or innovation parks that facilitate more innovation between the private sector and academia.

Lastly, the government creates policies that allow for start-ups and other larger companies to innovate and grow. The Federal Act on the Promotion of Research and Innovation (RIPA) controls the tasks and arrangements of federal support for R&D investments in the private sector in Switzerland.<sup>169</sup> RIPA supports business startups and ensures that the environment at the innovation parks is facilitating healthy innovation between the universities and private sector. One great policy that the Swiss have in place is their tax and credit system for innovative enterprises. Switzerland will exempt taxes for up to ten years for some innovative enterprises.<sup>170</sup>

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<sup>160</sup> Hotz, 2012.

<sup>161</sup> Galia Kondova. "The "Crypto Nation" Switzerland 2018". *Hochschule Luzern*, 2018.

<sup>162</sup> Omer Derindag, Maya Lambovksa, and Daniela Todorova. "Innovation Development Factors: Switzerland Experience". *Pressburg Economic Review – Vol 1. No. 1*, 2021.

<sup>163</sup> Derindag et al, 2021.

<sup>164</sup> Ibid.

<sup>165</sup> Ibid.

<sup>166</sup> "Swiss Innovation Parks". *Switzerland Innovation*, 2021

<sup>167</sup> "Swiss Innovation Parks". 2021

<sup>168</sup> Ibid.

<sup>169</sup> Derindag et al, 2021.

<sup>170</sup> Ibid.

This policy is great for innovation in Switzerland, and it is no secret why the Swiss are always innovating at a high level.

It is important to note that Switzerland has been the most innovative country in Europe over the past few years because of their policies to facilitate innovation in the private sector and academia. Switzerland is not in the European Union, and not under their unnecessary constraints and regulations in the technology sector.

### Learning From Switzerland

In Switzerland, the government supports and even facilitates tech innovation in the private sector through their innovation parks. In Switzerland, RIPA is creating an environment that allows for innovation in technology in an ethical manner. They have multiple innovation hubs, or “parks” that span across many different cities in Switzerland. The U.S. government could unite the best universities in the world with tech companies and facilitate innovation in AI. The “innovation parks” could be located in cities where there is a high density of elite universities and tech companies like San Jose, Austin, Boston, and New York. They could also be created in places that have promising potential and a large talent pool that has not been tapped into like Pittsburgh, Buffalo, and Tampa.<sup>171</sup> The CHIPS Act establishes a clustered hub innovation approach in the Bill, so it is clear that the U.S. is learning from other countries and creating an ecosystem for AI in the future to flourish.

## South Korea

### The South Korean Miracle

Until the conclusion of World War Two, Korea was under the control of the Japanese.<sup>172</sup> This peninsula was mainly an agricultural economy that was under a dictatorship style of control and rule from the Japanese Emperor. After World War Two, the Korean War took place that essentially solidified South Korea as its own nation. Now, the former war torn, and poor country is the fifth most innovative country according to the global innovation index.<sup>173</sup> What has led to South Korea’s growth?

One explanation for their economic successes has been attributed to a top-down system.<sup>174</sup> South Korea has a close a close collaboration between the private sector, government, and academia.<sup>175</sup> Additionally, South Korea significantly invested in their research and development in the late twentieth and early twenty-first century.<sup>176</sup> According to the world bank, South Korea has the second highest R&D expenditure (% of GDP) in the world, only second to Israel.<sup>177</sup> Lastly, South Korea developed a strong capitalist country that facilitates innovation and growth in the

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<sup>171</sup> Johnson and Gruber, 2019.

<sup>172</sup> “KEY POINTS across East Asia—by Era 20th CENTURY 1900-1950”. *Asia For Educators – Columbia University*, 2022.

<sup>173</sup> “Global Innovation Index. 2021”. *Portulans Institute*, 2022.

<sup>174</sup> Leigh Dayton. “How South Korea made itself a global innovation leader”. *Nature Publishing Group*, 2020.

<sup>175</sup> Dayton, 2020.

<sup>176</sup> Ibid.

<sup>177</sup> “Research and development expenditure (% of GDP) - Israel, United States, Belgium, Netherlands, China, Korea, Rep.” *World Bank*, 2022.

private sector.<sup>178</sup> These three pillars: capitalist markets, significant investment in R&D, and collaboration between the private sector, government, and academia, have allowed South Korea to become one of the most innovative countries in the world over a short period of time.

### South Korea's Innovation Hubs and R&D

South Korea has one of the most innovative and advanced information and communication technology (ICT) sectors in the world.<sup>179</sup> South Korea is home to global leading companies in the ICT space, such as Samsung, LG Electronics, and Naver. Samsung is the 4<sup>th</sup> largest technology company in the world according to the last Forbes ranking.<sup>180</sup> Samsung is the first non-American company on that list. It supplies the world with some of the most cutting-edge technologies in the ICT industry. What policies allowed for South Korea to innovate so well?

Samsung is a world leading company in the ICT industry. In the early 2000s, Samsung petitioned to develop a private-driven industrial park south of Seoul, with the support of the government.<sup>181</sup> This industrial park was to include new factories, infrastructure, and school development.<sup>182</sup> The government supported the development of local innovation hubs or parks for specific companies or industries. This is not an uncommon practice. Switzerland has innovation parks where the best technologies are developed through a private-sector lens with the research and development from academic institutions, and government support.

Samsung has an extraordinarily interesting way of innovating through research and development. Samsung has partnered with ten academic institutions to help them develop the most cutting technology in the ICT industry. The list below includes the institutions that Samsung collaborates with.

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<sup>178</sup> Kosta, Anthony. "Capitalist maturity and South Korea's post-development conundrum". *Asia and the Pacific Policy Studies*, 2018.

<sup>179</sup> "South Korea – Manufacturing Technology – Smart Factory". *International Trade Administration*, 2022.

<sup>180</sup> Ponciano, 2022.

<sup>181</sup> Jin-hyo Yun, Sangmoon Park, Dong Wook Lim, Sung Hahm. "Emergence of east Asian TFT-LCD clusters: A comparative analysis of the Samsung cluster in South Korea and the Chimei cluster in Taiwan". *Asian Journal of Technology*, 2021.

<sup>182</sup> Yun et al, 2011.

Samsung Group's top ten collaborating academic partners on articles in the Nature Index journals are split between United States and domestic institutions. Here they are ranked by bilateral collaboration score (CS), 2015–19. CS is derived by summing each institution's Share on the papers to which authors from both have contributed.

Rank	Institution	Country	Bilateral CS	Count*
1	Sungkyunkwan University	South Korea	75.07	159
2	Seoul National University	South Korea	21.10	41
3	Korea Advanced Institute of Science and Technology	South Korea	20.16	35
4	Stanford University	United States	19.29	31
5	University of California, Berkeley	United States	17.16	51
6	Korea University	South Korea	13.62	27
7	Yonsei University	South Korea	11.07	22
8	Harvard University	United States	9.67	26
9	Pohang University of Science and Technology	South Korea	8.82	16
10	California Institute of Technology	United States	8.35	12

Figure 7. Samsung Group's Top Ten Collaborating Academic Partners.<sup>183</sup>

The research and development program in South Korea is effective. For example, the Gyeonggi-based Samsung Electronics, a subset of Samsung, is collaborating with SKKU Chemistry to develop a semi-conductor that can reduce the amount of radiation exposure while taking x-rays.<sup>184</sup> By 2010, South Korea had 105 regional innovation centers and 18 technology parks. In addition, South Korea has seven federal programs to strengthen the competitiveness of their innovation centers.<sup>185</sup>

### South Korea's Economic Policies

By 2022, South Korea has become the 11<sup>th</sup> largest economy and 5<sup>th</sup> largest exporter of goods and services globally.<sup>186</sup> Hyundai and Kia combined have emerged as third in vehicle production numbers, and Samsung and LG have evolved into world leading ICT developers.<sup>187</sup> South Korea's open market and education are playing a significant role in the success of South Korea's

<sup>183</sup> Dayton, 2020.

<sup>184</sup> Ibid.

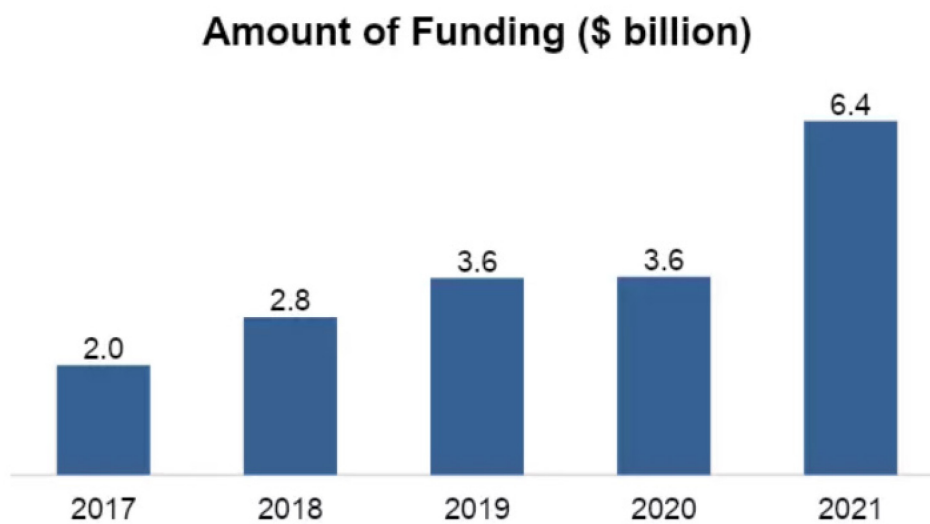
<sup>185</sup> Ibid.

<sup>186</sup> Saemoon Yoon. "This is how South Korea can become a global innovation hub". *World Economic Forum*, 2022.

<sup>187</sup> Yoon, 2022.

large companies. However, South Korea's recent development in the start-up industry is making for a more competitive and innovative markets that drive all companies.

Over the past few years, South Korea has developed new economic policies for startup companies and existing technology companies. South Korea developed a program, called TIPS (Tech Incubator Program for Startups). This state led innovation program nurtures promising startups and selectively matches them with government funding.<sup>188</sup> Korean startups have grown 78% year-on-year in 2021 and the amount of funding for these start-ups have nearly doubled.<sup>189</sup> The image below depicts the amount of funding for startups in South Korea from 2017-2021.



*Figure 8. South Korean Startup Funding from 2017 - 2021.<sup>190</sup>*

South Korea has emerged as an innovative economic powerhouse through great policy making. The government does not extensively regulate the private sector, rather it supports the private sector through funding and low regulation. The government also allows the private sector to develop innovation hubs around the country. These innovation hubs have significant R&D investments and are academically driven. Lastly, a lot of South Korea's innovative successes can be attributed to the culture in South Korea. South Korea is a disciplined culture that values education, which helps fuel the innovative economic powerhouse that it has evolved into today.

### Learning From South Korea

The United States could most certainly take some notes from how South Korea has innovated so well over the past 25 years, and especially as of late. One of the most important takeaways from South Korea's approach to innovation is their private sector driven innovation hubs. Although these are private sector driven, the government has supported them with funding as well. Additionally, the U.S. could learn from activities that occur inside the hubs. Major corporations are prioritizing R&D with ties to academic institutions. The U.S. could certainly use this model and increase the amount of R&D through innovation hubs. Silicon Valley has a great model as of

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<sup>188</sup> Ibid.

<sup>189</sup> Ibid.

<sup>190</sup> Ibid.



now; however, the U.S. could deliberately establish and fund innovation hubs in other areas with high concentrations of academic institutions and private sector companies like Boston, Austin, and New York City. As stated before, the CHIPS Act shows that the U.S. has learned from the Swiss and South Korea and will start to innovate in clustered hubs around the country.

Additionally, the U.S. could use some of the policy objectives in South Korea's TIPS program. The government is specifically funding promising startups and allows them to grow. The U.S. already does this to an extent; however, they could invest more into startups and create an environment that facilitates more innovation. The U.S. should not squash or punish innovative companies through extensive regulation of AI and other technologies. Rather, the government should help facilitate their growth.

Lastly, and maybe most importantly, the U.S. could learn something from South Korea's government-private sector-academia relationship. It is clear that Congress and some public sector organizations are not on the same page as the private sector. It seems at times that these two sectors are almost at war with each other. Congress is continually forcing private sector leaders such as Mark Zuckerberg, Elon Musk, Jeff Bezos, and others to testify. Where is our collaboration? If the U.S. could pool their resources together with a more unified public-private-academia triad relationship, the U.S. could see unprecedented growth in artificial intelligence.

## Singapore

### The Global Hub for Business

Singapore has taken a different approach to innovation compared to other countries. Singapore has attracted the largest companies around the world to conduct business in Singapore by creating an ecosystem that facilitates innovation and growth.<sup>191</sup> Singapore's digital economies is one of the best in the world due to global VC investments that pour into the country every year. The number of venture investments in Singapore for tech startups rose 20% year-on-year in the first half of 2021 and is continuing to grow at a rapid pace.<sup>192</sup> Singapore has a heavy reliance on foreign direct investment, and this strategy has paid off for Singapore as they have seen unprecedented growth in their economy since they were annexed from Malaysia in the 1960s.

In 2021, Singapore had the most capitalist economy based on the 2021 Heritage Index of Economic Freedom with a freedom score of 89.7 (The U.S. was not on the list).<sup>193</sup> Singapore was also the 8<sup>th</sup> most innovative country in the world in 2021 according to the Global Innovation Index.<sup>194</sup> These two statistics are most likely correlated as Singapore's business friendly environment that attracts many foreign investors to innovate inside their country, which in turn helps Singapore become much more innovative. Singapore also offers itself as a hub for innovation and R&D, offering companies around the world a great platform to grow their businesses.<sup>195</sup>

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<sup>191</sup> "How Singapore Brings Together the Best Innovation and Investment to Start-Up Growth". *EDB Singapore*, 2022

<sup>192</sup> "How Singapore Brings Together the Best Innovation and Investment to Start-Up Growth". 2022.

<sup>193</sup> "Capitalist Countries 2022". *World Population Review*, 2022.

<sup>194</sup> "Global Innovation Index – 2021". *Portulans Institute*, 2022.

<sup>195</sup> "Singapore: A Global Hub for Innovation" *Forbes Custom*, 2018.



Singapore is providing great opportunities for companies to develop AI, fintech, and digital economy innovations. Singapore has specifically set up innovation blocks to foster international innovation for foreign countries.<sup>196</sup> In addition to many foreign countries innovating in Singapore, nearly 4,000 tech start-ups, and 200 supporting organizations are present in Singapore to contribute to the country's growth.

### Singapore's Economic Policies

Singapore does an excellent job of attracting foreign investments and foreign driven innovation. One of the ways Singapore has attracted the most innovative companies in the world is through the newly found Economic Development Board (EDB).<sup>197</sup> The EDB's mission is to create sustainable economic growth, with vibrant business and good job opportunities for Singapore.<sup>198</sup> In 1970, the total FDI into Singapore was \$93 million. In 2017, the total FDI was \$63.6 billion, a 684x increase.<sup>199</sup> The structure and tradition of Singapore's government is a strict meritocratic style of government that doesn't tolerate corruption. Singapore's innovation is driven by capitalist policies that allow for growth and foreign attraction.

Companies such as Microsoft, IBM, Citi, and PayPal have large innovation centers in Singapore.<sup>200</sup> As a result of foreign development and venture capital efforts, Singapore is a world class global competitor in cloud computing, artificial intelligence, quantum computing, and fintech.<sup>201</sup> Singapore offers a special market that allows for sandbox experimentation, which allows for emerging technologies to perform in real life scenarios before they are deployed in society.<sup>202</sup> There are 4,500 U.S. companies in Singapore because of Singapore's market driven society, and opportunities to experiment with developed technologies.<sup>203</sup> The U.S. could learn from Singapore's policies and make it easier for foreign companies to innovate and develop inside the U.S.

### Learning From Singapore

Singapore's innovation is driven by different factors compared to Israel, Switzerland, and South Korea. All of them have specific developed innovation hubs to develop innovative technologies; however, Singapore is clearly one of the best at attracting foreign investments and talent to their country. The reason Singapore is so sought after for innovation is because of their market driven capitalist policies and sandbox experimentation opportunities for emerging technologies. The United States could relax some of their regulatory frameworks to encourage more foreign and U.S. companies to innovate inside the United States. However, the United States has experienced a significant number of U.S. companies outsource innovation to other countries. The CHIPS Act does address the semiconductor production in Taiwan and brings more domestic production and

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<sup>196</sup> "Singapore: A Global Hub for Innovation". 2018.

<sup>197</sup> Clayton Christensen, Efosa Ojomo, and Karen Dillion. "How Investment Made Singapore an Innovation Hub". *Barrons*, 2019.

<sup>198</sup> Clayton et al. "How Investment Made Singapore an Innovation Hub". 2019.

<sup>199</sup> Ibid.

<sup>200</sup> Frances Goh. "10 Innovation Labs To Visit In Singapore". *Collective Campus*, 2017.

<sup>201</sup> Mishell Arwan. "Information and Telecommunications Technology". *International Trade Administration*, 2022.

<sup>202</sup> Arwan. "Information and Telecommunications Technology". 2022.

<sup>203</sup> Ibid.

innovation to the United States; however, the U.S. needs to encourage more companies to innovate artificial intelligence in the U.S.

Lastly, the U.S. could learn from Singapore's AI strategy. AI Singapore (AISG) is a national research and innovation program that funds and promotes research in each of its 64 districts.<sup>204</sup> The AISG attention and resources funds local and city-specific AI activities and research.<sup>205</sup> Singapore's economic policies allow for a more decentralized approach to innovation. The AI environment in areas like Boston and Silicon Valley may have different needs than places like Austin and Seattle. It would be difficult for the U.S. to transition to this model; however, a decentralized AI policy for specific sectors and locations could help the development and ethical deployment of emerging technologies in specific areas.

## European Union

### France and the Airbus

Today, Airbus makes up half of the world's aircrafts, sharing 99% of all large aircraft production with Boeing.<sup>206</sup> Recently, Airbus has gained an edge over Boeing as a result of China's announcement to buy \$12.2 billion worth Airbus planes in machinery in July of 2022.<sup>207</sup> How has Airbus been able to innovate so well and compete with (and sometimes outperform) Boeing? What policies in France and Europe allowed for Airbus's rise in innovation and market dominance?

Airbus was originally created in 1967 from an agreement between the French, German, and British governments to strengthen their cooperation in the field of technology.<sup>208</sup> Airbus was born as a result of the urge for a European company to drive innovation and dominance in the aerospace industry. Airbus innovated in part as a response to Boeing's dominance in the aerospace industry in the late 1960s. The President of France at the time, President de Gaulle, had a strong commitment to compete with American dominance in this industry though more innovation and cooperation with other European countries like the United Kingdom.<sup>209</sup>

The key to Airbus's success was government cooperation among European nations and a drive to compete with the American market. By the end of the 1960s, Airbus's development mainly occurred in France; however, body and wing sections were completed in Germany and Great Britain.<sup>210</sup> Airbus was driven by government vision and innovation. Over the next few decades, with the collaboration of European countries (Great Britain dropped out), Airbus evolved into a major competitor for Boeing.<sup>211</sup>

<sup>204</sup> Hodan Omaar. "U.S. States Can Succeed in AI by Looking at Singapore". *U.S. News*, 2020.

<sup>205</sup> Hodan. "U.S. States Can Succeed in AI by Looking at Singapore". 2020.

<sup>206</sup> Bryan Shelmon. "Why Airbus and Boeing Have No Competition and Dominate the Market". *Simple Flying*, 2019.

<sup>207</sup> Regis Duvignau. "Chinese state airlines to buy almost 300 Airbus jets". *CNBC*, 2022.

<sup>208</sup> David Slotnick. "'Airbus is one of the most powerful companies in aviation. Here's a closer look at its rise from upstart to industry titan". *Business Insider*, 2020.

<sup>209</sup> Geir Lundestad. "De Gaulle's Challenge to America's Hegemony, 1962–1969 - The United States and Western Europe Since 1945". *Oxford*, 2003.

<sup>210</sup> Bill Sweetman. "The Contender – How Airbus got to number one". *Smithsonian Magazine*, 2003.

<sup>211</sup> Sweetman. "The Contender – How Airbus got to number one". 2003.

Airbus emerged as a world leader when the European Aeronautic Defense and Space Company (EADS) formed in 2000 and made an agreement to buy Airbus.<sup>212</sup> EADS is partially owned by the French government and helps to drive the innovation at Airbus.<sup>213</sup> However, Airbus's innovation today is also driven by private sector and academic driven research and development.

Former CEO of the Airbus Group, Tom Enders states that Airbus has succeeded as of late because of the company's willingness to fail early and fail often.<sup>214</sup> This mindset is not the traditional European mindset when it comes to innovation and entrepreneurship and often is more associated with the culture in Silicon Valley. He alluded that Airbus's recent successes can be attributed to the willingness to try new things and to avoid being risk averse. However, he did state that he believes the industry features too much risk averse nature where companies are being led by government red-tape, rather than shaping new opportunities for the future.<sup>215</sup>

Airbus is innovating through programs like "Bizlab accelerators", which aims to reduce the time required to commercialize in-house innovations.<sup>216</sup> Additionally, Airbus has academic partnerships by joining the Virginia Commonwealth Center for Advanced Manufacturing to re-invigorate the industrial-academic partnership in France and the U.S. Airbus is innovating through a three-pronged system that includes a government-private sector-academic approach to innovation in the field of aerospace.

#### Lessons Learned from France and Airbus

One of the most important lessons learned from the development of the Airbus company is that it was formed in response to American innovation and dominance in the aerospace industry. In the late 1960s, Europe wanted to compete in the aerospace industry, so European countries collaborated to innovate better than the United States. The government funded and drove a lot of the innovation that took place in Airbus. Airbus now is partially owned by the government; however, they have a great relationship with the private sector that allows them to innovate.

The competition in the aerospace market between Airbus and Boeing is arguably good for the world because it forces the two companies to continue to innovate and deliver better products to consumers. If one of these two companies fails to continue to innovate in their company, then the other will emerge as a monopoly of the market.

Today, Europe is invested in the aerospace industry, and they are innovating at the same level, if not at a higher level than Boeing. The United States could learn from Airbus's government supported and driven growth in the aerospace industry. The EU allows for Airbus to innovate; however, they have a great relationship with Airbus and supports their innovation.

#### Europe's Response to New Technology

It is interesting to note that this is not the approach you see Europe taking today in the big tech industry. Rather than responding to American dominance in the big tech space through

<sup>212</sup> Stanley Weiss. "European Aeronautic Defense and Space Company". *Britannica*, 2015.

<sup>213</sup> Daniel Michaels and David Pearson. "Daimler, Lagardère to Sell Stakes in EADS". *The Wall Street Journal*, 2012.

<sup>214</sup> Bellamy Woodrow. "Tom Enders Outlines the Airbus Innovation Strategy". *Aviation Today*, 2015.

<sup>215</sup> Bellamy. "Tom Enders Outlines the Airbus Innovation Strategy". 2015.

<sup>216</sup> Bellamy, 2015.

increasing innovation, Europe is doing the exact opposite of what it did with Airbus in the 1960s. They are not cooperating among European countries and attempting to challenge U.S. driven innovation; rather they are regulating U.S. companies and not pushing for innovation in the field of artificial intelligence among other fields.

It seems that Europe has taken a defensive posture, and instead of attempting to develop their own new technology in the big tech space, they are retracting and regulating big tech. Perhaps Europe and the United States should take the words of former Airbus CEO Tom Enders into consideration, “Companies are being led by government red-tape, rather than shaping new opportunities for the future”. Governments should aid in private sector innovation by facilitating new opportunities for the future, not red-taping industries.

### Germany and the Car Industry

Germany has had a long history of unparalleled innovation and development in the automotive industry. Germany has produced and is still producing some of the most innovative and popular cars led by Volkswagen, Mercedes-Benz, BMW, Audi, and Porsche. In 2021, German automobile manufacturers produced 15.6 million vehicles and led European car production.<sup>217</sup> Fifteen of the world’s 75 top automotive suppliers are German companies.<sup>218</sup> Today, they are also leading innovation in environmentally friendly cars and E-mobility production. Germany has had a reputation of efficiency and innovation in their prestigious brands. How did Germany get there? What policies in the twentieth century and today have allowed for unparalleled German innovation in the automotive industry?

In 1886 Carl Benz was awarded a patent for the Motorwagen, which was a three-wheeled vehicle with a rear mounted single cylinder engine.<sup>219</sup> Karl Benz formed the Benz & Cie company in 1883 prior to his invention. Another company, the Daimler-Motormen-Gesellschaft (DMG) company was formed in 1890 by lifelong business partners Gottlieb Daimler and Wilhelm Maybach.<sup>220</sup> These two companies eventually merged into the company Daimler-Benz in 1926 and we mostly controlled by the Nazi government until the end of World War Two.

After World War Two, Daimler-Benz experienced great innovation and growth into the 1950s. In the 1950s, Daimler-Benz opened plants all around the world to include Brazil, Turkey, Argentina, and India.<sup>221</sup> After 1949, the Federal Republic of Germany was established, and the new republic needed a system of public transportation after the war. The key to Daimler – Benz growth was that they looked for international opportunities to expand and they had a government that supported their efforts.<sup>222</sup> Today, (Now Mercedes Benz) is one of the most innovative companies in Europe. The government supports the German auto industry and helps to drive innovation.

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<sup>217</sup> “The Automotive Industry in Germany”. *Germany Trade and Invest (GTAI)*, 2022.

<sup>218</sup> “The Automotive Industry in Germany”. 2022.

<sup>219</sup> Martin Luenendonk. “The History of Mercedes-Benz”. *Cleverism*, 2019.

<sup>220</sup> Luendendonk. “The History of Mercedes-Benz”. *Cleverism*, 2019.

<sup>221</sup> Luendendonk. 2019.

<sup>222</sup> Ibid.

Volkswagen is another successful and innovative German auto company that originally started just before World War Two. After the war, Volkswagen expanded rapidly in the 1950s and started to develop cars on an international scale. The Beetle, developed in 1959, became the most popular imported car in the United States during the 1960s.<sup>223</sup> Volkswagen had unusually close ties to the government during this time of rapid growth and the government supported all of their efforts.<sup>224</sup> Since Volkswagen's emergence as a world leader in car production, the government has been an advocate of the car industry and constantly facilitating an environment of innovation for the private sector.

### Lessons Learned from Germany

Not only does the German government support and facilitate an environment for innovation in the car industry, but the culture of German car making also is a critical part of their success. The culture of the German car industry helps to drive innovation, just as the culture in places like China drives artificial intelligence. The two most important takeaways from German success in the auto industry is that the government supports German innovation through facilitating an environment where the private sector can innovate well, and that the culture of Germany facilitates the innovation in the auto industry.

Culture is often overlooked when it comes to innovation. Developing a culture of innovation for specific sectors is important for countries who want to innovate moving forward in that field. The government can help facilitate that culture through academic programs and provide more opportunities for growth in the private sector. If the government does not support the innovations taking place in a specific industry, it can curtail innovation in that industry through unnecessary regulations and influence the culture.

Aside from these two takeaways, another important lesson learned from the German auto industry is the power of international markets. Volkswagen and Mercedes-Benz substantially grew and innovated better when they expanded their market beyond the German border. It is important for emerging markets to take advantage of the international market to drive innovation.

## A Different Objective - Regulations

### California Data Privacy Laws – The European Approach

In 2018, California passed its California Consumer Privacy Act (CCPA), which is a law that was established to protect the privacy rights of consumers within the state of California.<sup>225</sup> This state law allows for Californians to sue businesses if their personal information is compromised in a data breach. It also requires businesses to implement new policies and procedures to ensure the protection of personal information for California residents.<sup>226</sup>

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<sup>223</sup> "Volkswagen Group" *Britannica Editors*, 2021.

<sup>224</sup> Dan Gearino. "Love is Blind: How Germany's Long Romance with Cars Led to the Nation's Biggest Clean Energy Failure". *Inside Climate News*, 2020.

<sup>225</sup> Anna Attkisson. "How California's Consumer Privacy Act Will Affect Your Business". *Business News Daily*, 2022.

<sup>226</sup> Attkisson. "How California's Consumer Privacy Act Will Affect Your Business" 2022.

So far, critics of the CCPA claim that the legislation has been ineffective and expensive. The California Department of Justice, who has the responsibility of bringing privacy act lawsuits in California under the CCPA has sent numerous warnings to companies but did not take any companies to court in its first year.<sup>227</sup> Jennifer King, the privacy, and data policy fellow at Stanford's Human-Centered Artificial Intelligence Institute stated, "I think it's a bit of a mess so far, is what I'm observing... How do we assess whether this law is working?"<sup>228</sup>

Eric Goldman, a law professor at Santa Clara University stated, "The data is functionally useless".<sup>229</sup> The data he is referring to is the data that companies in California are expected to report regarding online data privacy. Goldman sees the CCPA as a pointless and expensive law as a result of the inefficient data collection and reporting by the state of California.<sup>230</sup>

According to an economic analysis report from the California attorney general, The CCPA presented a total operational and compliance cost of \$55 Billion.<sup>231</sup> The big tech companies will be able to meet the cost requirements to comply with the CCPA; however, the smaller businesses will not have the resources or capital to meet the demands of CCPA. A recent study by a technology security firm (CYTRIO) found that 89% percent of affected companies in the United States are not compliant or partially compliant with the CCPA's regulatory framework.<sup>232</sup> The market is not ready for these regulations and many small businesses in California are going to go out of business because they cannot meet the compliance cost of the CCPA.

Additionally, a recent study from the University at Buffalo found that although the CCPA was intended for consumer facing digital companies, California's healthcare organizations face several challenges and are impacted significantly.<sup>233</sup> The study attributes these unforeseen consequences to the high compliance costs required to meet the CCPA's regulatory framework. Overall, many believe that the CCPA seems to be a taking step in the wrong direction because the market is not ready for the regulatory framework and the data collection process is not efficient.

### The GDPR – Impact on Innovation

The European Union emplaced strict regulations on data privacy in 2018 through their General Data Protection Regulation (GDPR) to protect the privacy of EU citizens.<sup>234</sup> The GDPR came out in 2018 with the aim of strengthening the information privacy of European Union citizens.<sup>235</sup> The GDPR has been coined "The Magna Carta of Data Protection"; however, there are many unintended consequences as the GDPR hurts innovation for European businesses and businesses

<sup>227</sup> Susannah Luthi. "Functionally useless!: California privacy law's big reveal falls short". *Politico*, 2021.

<sup>228</sup> Luthi. "Functionally useless!: California privacy law's big reveal falls short". 2021.

<sup>229</sup> Luthi, 2021.

<sup>230</sup> Ibid.

<sup>231</sup> Pat Kudisha. "The impending fallout from various new data privacy policies". *Cal Matters*, 2022.

<sup>232</sup> Kudisha. "The impending fallout from various new data privacy policies". 2022.

<sup>233</sup> Pavankumar Mulgund. "The implications of the California Consumer Privacy Act (CCPA) on healthcare organizations: Lessons learned from early compliance experiences". *Health Policy and Technology*, 2021.

<sup>234</sup> Michelle Goddard. "The EU General Data Protection Regulation (GDPR): European regulation that has a global impact". *International Journal of Market Research* Vol. 59 Issue 6, 2018.

<sup>235</sup> Wanda Presthus and Kaja Sonslien. "An analysis of violations and sanctions following the GDPR". *International Journal of Information Systems and Project Management*, 2021.

worldwide. Two significant consequences of the GDPR are that it limits competition in data markets, creating more concentrated market structures by entrenching the market power to companies that are already powerful, and it limits data sharing between different data collectors, which prevents the realization of data sharing that can often lead to better data.<sup>236</sup>

In 2019, EU firms experienced a 26.1 decrease in monthly venture deals from 2018, and small businesses inside the EU are struggling to meet the European Commission's data compliance.<sup>237</sup> Additionally, a 2018 EU and International Association of Privacy and Professional report found that companies in Europe and the United States spent an average of \$1.3 million per year on GDPR compliance costs.<sup>238</sup> How are start-ups and smaller companies in Europe supposed to comply with the GDPR requirements if they must spend \$1.3 million on compliance? They simply won't survive in the long term in the European market. The GDPR is killing small businesses and stalling innovation for both start-ups and larger companies.

Over the course of two years (2018-2020), the EU fined over 200 companies for a total of 150,000,000 euros by March 31<sup>st</sup>, 2020.<sup>239</sup> A few reasons for the fines included "not following the principles of transparency, sufficiency of information and the presence of legal basis", "charging a copy fee, and violating a patient's right to access data", and "insufficient cooperation with supervising authorities".<sup>240</sup> The graph below shows the number of fines each country has received from the GDPR.

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<sup>236</sup> Michael Gal and Oshrit Aviv. "The Competitive Effects of the GDPR" *Journal of Competition Law and Economics*, 2020.

<sup>237</sup> "Unintended Consequences of GDPR". *Columbian College of Arts & Sciences*, 2020.

<sup>238</sup> Jennifer Huddleston. "The Price of Privacy: The Impact of Strict Data Regulations on Innovation and More". *American Action Forum*, 2021.

<sup>239</sup> Wanda Presthus and Kaja Sonslien. "An analysis of violations and sanctions following the GDPR". 2021.

<sup>240</sup> Presthus and Sonslien, 2021.



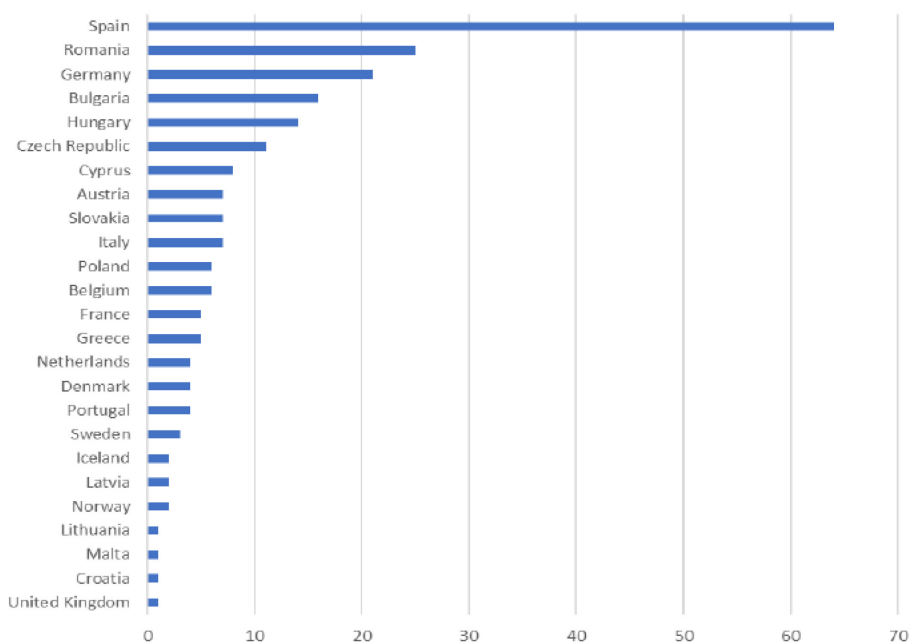


Fig. 4. Number of fines based on country

Figure 9. GDPR Punishments by Country.<sup>241</sup>

There is a clear discrepancy among different countries in the European Union in terms of punishment allocations. Spain is clearly hurting the most from the GDPR sanctions. The large diversity in sanctions could be explained by the fact that the GDPR replaced more than 40 privacy acts in European countries, and a unified understanding of the laws are still not achieved.<sup>242</sup> To contribute to Spain's heavy fines, in the summer of 2022 Google was fined 10 million Euros for violating the GDPR's "right to be forgotten" in Spain.<sup>243</sup> Google was fined because of the Harvard Berkman Klein's Lumen Project data collection process. This project collects cease-and-desist letters related to online activity with an objective to determine if it has any effect on free speech.<sup>244</sup>

#### The GDPR and Effect on Small Businesses, Startups, and Citizens in the EU

Smaller companies and startups are clearly struggling to meet the compliance of the GDPR. As stated above, companies on average are spending an average of \$1.3 million to meet the compliance of the GDPR. A National Bureau of Economic Research working paper found that venture capital investment in small and micro companies decreased by \$3.4 million per week following GDPR's enactment.<sup>245</sup> This is not surprising at all. Innovators and entrepreneurs in the EU are either deciding to innovate elsewhere or simply not pursuing their ambitions to innovate and help others at all. The large companies have the ability to absorb some of the upfront costs of

<sup>241</sup> Ibid.

<sup>242</sup> Ibid.

<sup>243</sup> Scott Ikeda. "Spain Hands Google €10 Million GDPR Fine for Violation of "Right To Be Forgotten" Rules". CPO Magazine, 2022.

<sup>244</sup> Scott Ikeda. "Spain Hands Google €10 Million GDPR Fine for Violation of "Right To Be Forgotten" Rules". 2022.

<sup>245</sup> Jennifer Huddleston. "The Price of Privacy: The Impact of Strict Data Regulations on Innovation and More". 2021



the GDPR compliance laws; however, the small companies simply cannot afford to meet Europe's compliance. European citizens and small companies are scrambling to catch up with these laws and companies all around the world are unnecessarily suffering from the EU's GDPR laws.

EU citizens are also experiencing some of the negative effects of the GDPR. Companies like the Los Angeles Times and Pottery Barn (email management services) have all quit their online services to the EU following the release of the GDPR.<sup>246</sup> Meta platforms have threatened to pull Facebook and Instagram from Europe if it is unable to keep transferring data back to the United States.<sup>247</sup> In July of 2022, The Irish Data Protection Commission stated that it will block Meta from sending user data from Europe to the United States.<sup>248</sup> European citizens will continue to see a decline in services available to them if the GDPR continues to remain in law.

### Europe's AI Act – A Different Objective

In 2022, the European Union published its first draft of their AI Act in an attempt to regulate artificial intelligence systems. The EU's proposal outlined a comprehensive risk classification framework that categorizes AI systems into four groups: unacceptable, high risk, limited risk, and low risk.<sup>249</sup> Europe's law is based on the underpinning idea that AI should only be deployed in society if it does not risk violating consumer protection.<sup>250</sup> In Europe, it is clear that slowing down innovation is less of a concern than establishing desirable regulatory frameworks.<sup>251</sup> Many critics claim that the main issue with Europe's law is that with the fast-moving pace of AI, the laws cannot keep up with emerging technologies.

Individuals who oppose Europe's AI Act point to the emergence of foundation models since the EU drafted their AI Act. Foundation models were not addressed in Europe's AI Act, and now Europe seems to be scrambling to draft new legislation to address the emergence of these large pretrained models. Foundation models like ChatGPT, GPT-3, and The Wu Dao 2.0. PaLM, and BERT, are drastically changing the landscape of artificial intelligence and they have emerged on the scene since the EU drafted their Act.

As it stands today, Europe's AI Act does not address foundation models.<sup>252</sup> Europe is trying to reclassify these models and call them "General Purpose Artificial Intelligence Systems", or GPAIS.<sup>253</sup> Regardless of what Europe decides to call these pretrained models, it is clear that Europe is now scrambling to address GPAIS models in their Act. By the time they address these

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<sup>246</sup> Huddleston, 2021.

<sup>247</sup> Jillian Deutsch. "Data spat: Meta threatens to pull Facebook, Instagram from Europe". *Bloomberg*, 2022.

<sup>248</sup> Vincent Manancourt. "Europe faces Facebook blackout". *Politico*, 2022.

<sup>249</sup> Carlos Gutierrez et al. "A Proposal for a Definition of General-Purpose Artificial Intelligence Systems". *Future of Life Institute*, 2022.

<sup>250</sup> Keith Chan et al. "Balancing the Tradeoff between Regulation and Innovation for Artificial Intelligence: An Analysis of Top-down Command and Control and Bottom-up Self-Regulatory Approaches". *The Hong Kong University of Science and Technology*, 2022.

<sup>251</sup> Chan et al. "Balancing the Tradeoff between Regulation and Innovation for Artificial Intelligence: An Analysis of Top-down Command and Control and Bottom-up Self-Regulatory Approaches". 2022.

<sup>252</sup> Carlos Gutierrez et al. "A Proposal for a Definition of General-Purpose Artificial Intelligence Systems". 2022.

<sup>253</sup> Gutierrez, 2022.

models and figure out a way to regulate them in Europe, another model in the field of AI will likely emerge that the EU does not address, and parliament will be forced to draft another version of the Act again.

Opponents of Europe's AI Act claim that instead of trying to regulate the current fast-moving field of AI, Europe should try to innovate. Europe is struggling to generate innovation in the field of artificial intelligence because of their extensive regulations. Their Act does not allow entrepreneurs to take risks and it will hurt new innovative startups that are attempting to develop AI systems. The large companies will be able to pay the necessary funds to comply with the EU AI act; however small innovative startups will not.

While Europe continues to regulate a field that moves too fast, the United States and China will continue to widen the gap in AI capabilities if Europe does not change its approach to their AI policy. Europe seems to have a different objective – to regulate AI systems to ensure the protection of their citizens, knowing that their innovation will stifle. There is no right answer to the innovation vs consumer protection tradeoff; however, Europe is clearly promoting consumer protection at the cost of innovation.

### Changing the European Innovation Narrative

Western Europe and the United States are on the same page regarding many issues. The U.S. and much of Western Europe have agreements through NATO and other treaties. However, the U.S. and the EU have their differences when it comes to data privacy and innovation. As of late in Europe, there is a larger cultural stigma of failing, especially in business and entrepreneurship.<sup>254</sup> Petra Moser, assistant professor of economics at Stanford and its Europe Center, who was born in Germany, attributes the lack of recent innovation in Europe to cultural differences and structure of law.<sup>255</sup>

In the United States there is a difference in the outlook on risk and entrepreneurship. In Silicon Valley, failure is seen as almost a necessity to become successful. In Europe, failure is not as forgiving.<sup>256</sup> Many Europeans are trying to change this narrative by building “Silicon Alle” and “Isar Valley” in Berlin, and “Silicon Docks” in Dublin; however, none of these innovation hubs have amounted to much.<sup>257</sup>

Jacob Kirkegaard, a Danish Economist, and senior fellow at the Peterson Institute stated “They (European Cities) all want a Silicon Valley, but none of them can match the scale and focus on the new and truly innovative technologies you have in the United States. Europe and the rest of the world are playing catch-up, to the great frustration of policy makers there”.<sup>258</sup> This statement was made in 2015, and it seems that Dr. Kirkegaard's advice was not taken. Rather than trying to

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<sup>254</sup> James Stewart. “A Fearless Culture Fuels U.S. Tech Giants”. The New York Times, 2015.

<sup>255</sup> Stewart. “A Fearless Culture Fuels U.S. Tech Giants”. 2015.

<sup>256</sup> Stewart. 2015.

<sup>257</sup> Ibid.

<sup>258</sup> Ibid.

catch-up, many believe that Europe has taken a step backward with the GDPR. Peter Moser continued in the conversation to say, “Europeans are worried”.<sup>259</sup>

The GDPR certainly isn’t helping the stalling of innovation in Europe. In fact, it is disincentivizing people more to take risks and innovate in Europe. Many claim that the GDPR is making the cultural outlook on risk and entrepreneurship worse, and the European people and economy are clearly suffering from it. The U.S. needs Europe to innovate better to help the U.S. combat common near peer threats like China and Russia. Some policy makers in Europe are starting to realize that the EU needs to address their lack of innovation before it’s too late and will not have the opportunity to catch up to innovative countries. The EU and the United States need to work together more on innovating AI. There is great potential for both Europe and the United States if Europe chooses a path with less regulation and more innovation. Together, the U.S. and Europe innovate artificial intelligence that benefits the entire world on a larger scale if Europe alters its regulatory path.

## Movements in the Right Direction

[The CHIPS \(Creating Helpful Incentives to Produce Semiconductors for America\) Act](#)

On August 9<sup>th</sup>, 2022, President Biden signed the CHIPS Act, which was presented in the House in 2020 and has passed through Congress with Bipartisan support.<sup>260</sup> This Bill establishes investments and incentives to support U.S. semiconductor manufacturing, research and development, supply chain security, invest in research and development, science and technology, and artificial intelligence.<sup>261</sup> The CHIPS Act provides \$52.7 Billion for American semiconductor research development, manufacturing, and workforce development.<sup>262</sup> \$13.2 Billion will also be allocated to research and development in the sciences like artificial intelligence and workforce development.<sup>263</sup>

Aside from the benefits of creating domestic semiconductor chips and becoming less reliant on Chinese chip development, this act will advance U.S. global leadership in the technologies for the future. Technologies such as artificial intelligence and quantum computing will now have public backed R&D which will lay the foundation for more innovation in the field of AI to take place. Additionally, this act authorizes \$10 Billion to invest in regional innovation and technology hubs across the country, which will bring together state and local governments, academic institutions, and the private sector.<sup>264</sup>

The regional hubs will include at least three new hubs in each of the economic development regions by the end of fiscal year 2023.<sup>265</sup> These hubs are not yet named. There will also be a

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<sup>259</sup> Ibid.

<sup>260</sup> “FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”. *The White House Briefing Room*, 2022.

<sup>261</sup> “FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”. 2022.

<sup>262</sup> Ibid.

<sup>263</sup> Ibid.

<sup>264</sup> Ibid.

<sup>265</sup> Ibid.

“Recomplete Pilot Program” to support distressed communities in the United States that lack innovation and could use an economic boost from innovation. There is currently a wide gap between the few local innovation centers in the United States and the rest of the country. According to a recent Brookings research initiative, half of all U.S. innovation jobs are concentrated in just 41 counties, underscoring the need for a better distribution of innovation in the United States.<sup>266</sup> As the map below shows, these innovative hubs are centered mostly around the coasts, with Silicon Valley, Boston, Seattle, among other hubs significantly leading the way.

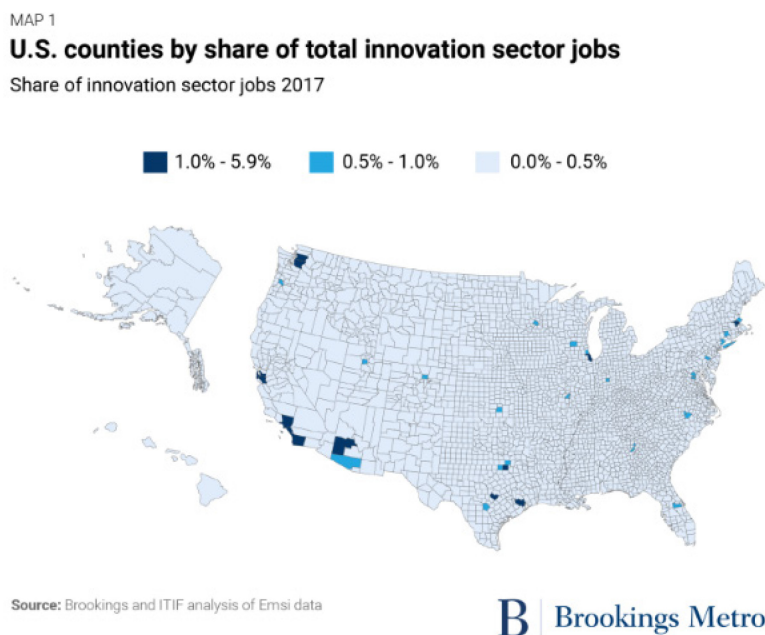


Figure 10. Share of total innovation by county in the United States.<sup>267</sup>

A portion of the legislation outlined in the CHIPS Act was drawn from “Jump Starting America” by MIT economists Jonathon Gruber and Simon Johnson.<sup>268</sup> These two authors argued that publicly funded research and development with the support of the private sector and academia, produces the most innovation in the United States.<sup>269</sup> They outline how after World War Two, the United States experienced an unprecedented period of growth and innovation because the public sector invested in research and development that allowed the U.S. to lead the world in innovation. The public sector investment in R&D also elevated the quality of life and income for middle class Americans.<sup>270</sup>

However, since the 1970s, the United States has lost interest in investing in science through R&D and have left the private sector to lead the research and innovation. This has allowed

<sup>266</sup> Markl Muro. “Can the CHIPS Act heal the nation’s economic divides?”. *Brookings*, 2022.

<sup>267</sup> Muro. “Can the CHIPS Act heal the nation’s economic divides?”. 2022.

<sup>268</sup> Ashleigh Maciolek and Ben Olinsky. “The CHIPS and Science Act Will Boost Competitiveness and Promote Inclusive Growth”. *CAP*, 2022.

<sup>269</sup> Jonathan Gruber and Simon Johnson. “Jump-Starting America”. *Public Affairs – Hachette Book Group*, 2019. New York

<sup>270</sup> Gruber and Johnson, 2019.

countries like China, Japan, Canada, and other countries to catch the United States in innovation.<sup>271</sup> Johnson and Gruber proposed a plan that would regionalize innovation through publicly funded R&D innovation hubs. The key to innovation for the United States in the past has been publicly funded R&D, with the private sector and academia uniting to innovate for the American people. These two authors outline potential cities like Rochester, NY, Pittsburgh, PA, Buffalo, NY, Columbus, OH, and many others that can be hubs for American innovation.<sup>272</sup>

Obviously, publicly funding existing hubs like Cambridge/Boston, San Francisco/San Jose, Seattle, and Austin are important as well; however, for all Americans to benefit, increasing the amount of innovation hubs can curate a pool of more talent and in turn more innovation for the United States. The CHIPS act is certainly a move in the right direction; however, the execution of the Act and the areas of focus in innovation is important as well. One of the most important emerging technologies moving forward is artificial intelligence. AI needs to be a priority at these innovation hubs. The locations of the hubs do matter, as there needs to be adequate talent, and private sector companies willing to support the publicly funded R&D. However, the chosen technologies to innovate are just as important, and AI needs to be on the forefront of the innovation that takes place at these innovation hubs.

## Conclusion – Lessons Learned

### Timing - Regulation

The timing of the seatbelt regulatory framework was great for the automobile industry because the technology was sufficient to protect people in the car. Before Nils Bohlin invented the three-point seat belt in 1959 with Volvo, implementing a regulation forcing cars to build seatbelts in them would have been an ineffective and harmful regulation. The technology of the original seatbelt designs was not safe. The government realized that the technology in the safety measures were sufficient to protect people after the three-point seatbelt was developed.

The timing of regulatory policies in technologies is just as important today. If the technology or practices are not sufficient to help protect and regulate emerging technologies like artificial intelligence, then the government should not emplace regulatory frameworks. Regulatory policies that rely on premature ineffective technology to regulate emerging technologies can harm the individuals using the technology in the same fashion as the seatbelt could have hurt the driver before 1959. The government needs to realize when we do in fact have the proper technology to regulate AI, and not to prematurely place regulations on emerging technologies like AI.

### Timing – Government Spurred Innovation

The Apollo 11 program showed the United States that the timing of government driven innovation is important. The private sector does not always need the aid of the government to spur innovation; however, the late 1950s was clearly a time when the U.S. government had to step into an industry and innovate for national security reasons. The timing of the United States Apollo 11 program was perfect. It was a great response to the Soviet Sputnik satellite and the

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<sup>271</sup> Ibid.

<sup>272</sup> Ibid.

Apollo 11 program with NASA bolstered the United States to lead the world in space innovation. It is important for the government to understand when the private sector needs aid and a push to innovate technologies that VCs and private sector investors would not want to take risks on.

The private sector in the United States has shown that it is capable of generating incredible technologies that lead the world. However, once a country starts to match or outpace the United States in a certain emerging technology like artificial intelligence, the U.S. government might need to act. China is catching the United States in terms of AI capabilities and the U.S. needs to determine if they need to step in to innovate. If China or another country starts to threaten our national security with an emerging technology like artificial intelligence, then the U.S. might want to look to the Apollo 11 program as an example to become the clear leader of an emerging technology.

### Scope

The deregulation in the U.S. energy sector during the late 1970s showed the importance of understanding the scope of the problem when regulating. As opposed to the energy sector policies, the automobile's seat belt regulatory frameworks success displayed how timing is important in regulatory policies. In the 1970s, the United States understood the scope of the problem in the energy sector and made the adjustments needed to reduce prices in the U.S. and spur innovation in renewable energy. The definition of scope according to the Merriam Webster dictionary is, "space or opportunity for unhampered motion, activity, or thought".<sup>273</sup> The United States saw an opportunity to improve the energy sector in the 1970s and took advantage of deregulating the energy market.

Moving forward, it is important for policy makers to understand the scope of the problem before regulating. The government misjudged the scope of the IBM monopoly and created an anti-trust lawsuit catastrophe that cost each party millions of dollars that were unnecessary over the span of five presidencies. The U.S. government understood the scope of the problem better when they addressed the Microsoft monopoly in the 1990s. The U.S. needs to understand the scope of regulatory policies with emerging technologies and innovative companies in the future.

### Tradeoffs Matter

Every country in the world would prefer to have the best innovation in the field of AI and also have the most ethical AI. Governments would also prefer to attract the best talent in the world while also having incredible national security. However, you cannot maximize both innovation and consumer protection or talent attraction and national security. This is why tradeoffs are important. Countries and organizations must view these tradeoffs in the lens of an optimization problem. Most countries are not willing to completely maximize one attribute and eliminate the other. Therefore, policy makers must have a minimum "baseline" standard for the attribute that is not being maximized. This baseline standard is country dependent; however, most countries will not maximize one attribute if the other does not meet the "baseline standard" of the other tradeoff.

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<sup>273</sup> "Scope". *Merriam-Webster Dictionary*, 2022

Tradeoff analysis is what makes AI policies around the world different. Each country defines which tradeoffs they want to maximize and which tradeoffs they will minimize with a specific baseline standard. It is exactly like a constrained optimization problem. The United States and European Union are two examples of countries who view the innovation vs consumer protection tradeoff differently. Tradeoffs are important and understanding the goal of AI in a respective country reflects their tradeoff analysis and in turn determines their AI policy framework. Tradeoff analysis will continue to evolve and shape AI policies.

#### Government – Private Sector Relationship

The relationship between industry leaders and public officials plays a significant role in innovation and development. All of the international and U.S. examples of innovation stemmed from a good relationship between the private and public sector. The government needs to facilitate an environment for private sector growth through programs, academia, and curbed regulations at times. The government should not be an oppressive regulator of emerging industries, rather they should be a facilitator of innovation and allow for the private sector to innovate well.

In the United States today, you see a battle between big tech and Congress. The United States Congress and big tech CEOs have their differences and do not seem to be on the same page at times. The CEOs of the four major tech companies in the United States (Apple, Microsoft, Amazon, and Meta) have all testified in front of Congress. China is catching the United States in AI development and innovation because industry leaders and the public sector are not on the same page. We should learn from our past and learn from others. The U.S. needs to return to innovating better than anyone in the world through a closer public and private sector relationship.



## Chapter 2: AI Policies Around the World

“Innovation is the ability to see change as an opportunity – not a threat”<sup>274</sup>

Forward: Chapter Two mostly pulls the texts from the AI policies for thirteen different countries. There is a lot of quoted text directly from each respective AI policy and there is not much interpretation on these AI policies. The purpose of this chapter is to outline each country's AI policy for the reader in order to understand the current global AI policy landscape without much interpretation or bias towards any country's AI policy. There is some opinion and interpretation; however, the bulk of this chapter is identifying the strategies and policies for each country.

### Section 1: United States AI Policy

#### **Mission Statement:**

“To ensure continued U.S. leadership in AI research and development, to lead the world in the development and use of trustworthy AI in the public and private sectors and prepare the present and future U.S. workforce for the integration of AI systems across all sectors of the economy and society”<sup>275</sup>

#### **Strategy:**

In 2020, the United States outlined 6 strategic pillars in their National Artificial Intelligence Initiative Act. These 6 pillars are innovation, advancing trustworthy AI, education and training, infrastructure, applications, and international cooperation. For innovation, the U.S. approach strengthens and leverages the unique and vibrant American R&D ecosystem, combining the strengths of government, academia, and industry.<sup>276</sup>

The U.S. will also advance trustworthy AI by ensuring AI technologies appropriately reflect characteristics such as accuracy, explainability and interpretability, privacy, reliability, robustness, safety, and security or resilience to attacks – and ensure that bias is mitigated. The pillar of education and training will ensure that U.S. workers are prepared for current and future jobs, increased attention is needed at all stages of education, training, and workforce development.<sup>277</sup>

The infrastructure pillar will increase access to data and computing resources, while broadening the community of experts, researchers, and industries participating at the cutting edge of AI R&D. Next, the applications pillar will delegate the application of research, development, demonstration, and use of AI in a wide range of applications across society to federal agencies.<sup>278</sup>

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<sup>274</sup> “Innovation is the ability to see change as an opportunity – not a threat”. *Plusx*, 2020.

<sup>275</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”. *United States Congress*. 2020.

<sup>276</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”. 2020.

<sup>277</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”.

<sup>278</sup> *Ibid*.

Lastly, the international cooperation pillar embodies how The United States is committed to promoting an international environment that supports AI R&D and opens markets for the U.S. and allies around the world. The United States supports international AI collaborations and partnerships that are grounded in evidence-based approaches, analytical research, and multi-stakeholder engagements that bring diverse perspectives together.<sup>279</sup>

### **Funding and Innovation**

In 2021, the United States released the National Institute of Standards and Technology legislation that authorized the following amounts to the National Science Foundation to establish a program that awards grants to eligible institutions of higher education to recruit and retain tenure-track or tenured faculty in artificial intelligence and related fields.<sup>280</sup>

- (1) \$868,000,000 for fiscal year 2021.
- (2) \$911,400,000 for fiscal year 2022.
- (3) \$956,970,000 for fiscal year 2023.
- (4) \$1,004,820,000 for fiscal year 2024.

Additionally, the federal government has authorized the following funding amounts to the National Institute of Standards and Technology to advance collaborative frameworks, standards, guidelines, and associated methods and techniques for artificial intelligence.

- (1) \$64,000,000 for fiscal year 2021.
- (2) \$70,400,000 for fiscal year 2022.
- (3) \$77,440,000 for fiscal year 2023.
- (4) \$85,180,000 for fiscal year 2024, and
- (5) \$93,700,000 for fiscal year 2025.

The National Artificial Intelligence Act assigned the Department of Energy Artificial Intelligence Research program to advance artificial intelligence tools, systems, capabilities, and workforce needs and to improve the reliability of artificial intelligence methods and solutions through research and development. Congress has decided to fund the Department of Energy Artificial Intelligence Research program \$200,000,000 for fiscal year 2021 and up to \$262,160,000 for fiscal year 2025.<sup>281</sup> Additionally, through the CHIPS Act, \$13.2 Billion will also be allocated to research and development in the sciences like artificial intelligence and workforce development.<sup>282</sup>

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<sup>279</sup> Ibid.

<sup>280</sup> “National Institute of Standards and Technology – Artificial Intelligence”. U.S. Congress, 2021.

<sup>281</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”. *United States Congress*. 2020.

<sup>282</sup> “FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”. *The White House Briefing Room*, 2022.

### The National Science Foundation

The United States government allocates large amounts of funds for the National Science Foundation to fund universities around the country. The United States uses a decentralized driven model to innovate in universities. The public and private sector work together to innovate in universities. The U.S. National Science Foundation announced the establishment of 11 new NSF National Artificial Intelligence Research Institutes, building on the first round of seven institutes funded in 2020. The combined investment of \$220 million expands the reach of these institutes to include a total of 40 states and the District of Columbia (NSF, 2021).

The NSF will be focusing their funds and developments in seven areas: human-AI interaction and collaboration, AI for advances in optimization, AI and advanced cyberinfrastructure, AI in computer and network systems, AI in dynamic systems, AI-augmented learning, AI-driven innovation in agriculture and the food system.<sup>283</sup>

The NSF is using both private and public sector organizations to innovate AI in universities. The NSF and Amazon are partnering to jointly support research focused on fairness in AI, with the goal of contributing to trustworthy AI systems that are readily accepted and deployed to tackle grand challenges facing society. Specific topics of interest include, but are not limited to, transparency, explainability, accountability, potential adverse biases and effects, mitigation strategies, validation of fairness, and consideration of inclusivity.<sup>284</sup>

Additionally, the NSF partners with public institutions, such as the Defense Advanced Research Projects Agency (DARPA) to innovate in the field of AI. The NSF and DARPA have teamed up to explore high-performance, energy-efficient hardware and machine learning architectures that can learn from a continuous stream of new data in real time. Both agencies issued calls for proposals focused on real-time machine learning and are now offering collaboration opportunities to awardees from both programs throughout the duration of their projects. This partnership is contributing significantly to the foundation for next-generation co-design of algorithms and hardware.<sup>285</sup>

### CHIPS Act

On August 9<sup>th</sup>, 2022, Congress passed the CHIPS and Science act of 2022 that invests heavily in artificial intelligence and semiconductor development.<sup>286</sup> Although the majority of the funding is geared toward semiconductor and chip development in the United States, the CHIPS Act of 2022 invests significant funds into the field of artificial intelligence. This act authorizes \$10 billion dollars to invest in regional innovation and technology hubs across the country.<sup>287</sup> It authorized a

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<sup>283</sup> "Artificial Intelligence at NSF". *The National Science Foundation*, 2021.

<sup>284</sup> "Artificial Intelligence at NSF". 2021

<sup>285</sup> Ibid.

<sup>286</sup> "CHIPS and Science Act of 2022". *The United States Congress*, 2022.

<sup>287</sup> "CHIPS and Science Act of 2022". 2022.

total of \$13.2 Billion for innovation in emerging fields of technology like artificial intelligence. The CHIPS Act is aiming to bring together the public sector, private sector, and academia to innovate for artificial intelligence in local hub locations around the United States.

The CHIPS Act was inspired from the book, “Jump Starting America”, written by MIT Sloan professors Simon Johnson and Jonathan Gruber.<sup>288</sup> These two advocate for the development of artificial intelligence and other technologies in local hubs to drive innovation. The model of the United States leaving the innovation in the field of artificial intelligence to the private sector is starting to change. The United States government is aiming invest more funds into the field of artificial intelligence to spur innovation and take advantage of uniting the public, private and academic sectors in the United States to develop more innovative and ethical AI.

It is important to note that the CHIPS Act was spurred from both the USICA and COMPETES Act. Before the CHIPS Act came into effect, the United States senate passed the United States Innovation and Competition Act (USICA) in July of 2021, and the house has passed the America Creating Opportunities for Manufacturing Pre-Eminence in Technology and Economic Strength (COMPETES) act in February of 2022. The original framework of the CHIPS Act was inspired by both USICA and the COMPETES act. Moving forward, the United States government will look to innovate in the field of AI through a more local innovation hub model with government funding.

### **Regulations and Penalties:**

In the United States, there is a lack of federal regulation and different states have implemented regulations on AI that allows for private sector values to drive the ethical norms of AI (Chen et al, 2022). The United States is attempting to pass the 2022 Algorithmic Accountability Act (AAA) which if approved would propose that the Federal Trade Commission develops a regulation for the impact assessment for the usage of automated decision systems for critical decisions.<sup>289</sup> As of now, it is unclear if the 2022 AAA will move forward and be passed in Congress. The AAA has significant hurdles that it needs to clear before it can be considered a realistic passable law in Congress.

The U.S. also has a subcommittee on artificial intelligence to oversee the ethical deployment of AI.

The Subcommittee on Artificial Intelligence has a role in United States approach to regulating and promoting fair use of AI deployment. The subcommittee shall provide advice to the President on matters relating to the development of artificial intelligence. The Subcommittee on AI will advise the President and cabinet on the following:

- a.) Bias, including whether the use of facial recognition by government authorities, including law enforcement agencies.

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<sup>288</sup> Ashleigh Maciolek and Ben Olinsky. “The CHIPS and Science Act Will Boost Competitiveness and Promote Inclusive Growth”. *CAP*, 2022.

<sup>289</sup> Jakob Mokander, Prathm Juneja, David S. Watson, and Luciano Floridi. “The US Algorithmic Accountability Act of 2022 vs. The EU Artificial Intelligence Act: what can they learn from each other?”. *Minds and Machines*, 2022.

- b.) Security of data, including law enforcement’s access to data and the security parameters for that data.
- c.) Adoptability, including methods to allow the United States Government and industry to take advantage of artificial intelligence systems for security
- d.) Legal standards, including those designed to ensure the use of artificial intelligence systems are consistent with the privacy rights (U.S. Congress, 2020).

The United States has established this task force to regulate and ensure there is fair use of AI in the United States. There are currently no fines.<sup>290</sup>

## Foreign Policy

As affirmed in the 2018 Department of Defense Artificial Intelligence (DOD AI) Strategy, the network of U.S. allies and partners offers an “asymmetric strategic advantage that no competitor or rival can match.”<sup>291</sup> The Joint Artificial Intelligence Center (JAIC) has built on the DOD AI Strategy with three pillars of international AI engagement: shaping norms around democratic values, ensuring data interoperability and working to create pipelines to enable the secure transfer of technology.<sup>292</sup> In its recommendations to the executive branch and Congress, the National Security Commission on Artificial Intelligence (NSCAI) has also expanded on how to achieve this aim through a “coalition of coalitions” approach to technology cooperation.<sup>293</sup>

The Deputy Defense Secretary, Kathleen Hicks stated that the U.S. Department of Defense is prioritizing China as its long-term, pacing challenge in the field of AI because of its increased military confidence, willingness to take risks and China's adoption of a coercive and aggressive approach to the Indo-Pacific region.<sup>294</sup> Kathleen Hicks is establishing China as the United States long-term threat in the field of AI, and she is leading the United States effort to improve the capabilities of U.S. AI.

Kathleen Hicks stated in her secretary address, “We want to harness from the very best of America in sourcing a broad, diverse set of potential partners and suppliers. That especially includes small businesses”.<sup>295</sup> Small businesses lead the nation in innovation by producing 16.5 times more patents than large patenting firms. The U.S. government will look to work with small businesses to help improve the capabilities of AI in the U.S. She additionally stated that U.S. universities and research groups will lead the way to more innovation in the United States.<sup>296</sup>

The one advantage the U.S. has, is that the United States often works in with other allies and China often does not work with many other countries.<sup>297</sup> The United States has joined 12 other

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<sup>290</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”. *United States Congress*. 2020.

<sup>291</sup> Zoe Stanley-Lockman. “Military AI Cooperation Toolbox Modernizing Defense Science and Technology Partnerships for the Digital Age”. *Georgetown University*, 2021.

<sup>292</sup> Zoe Stanley-Lockman. “Military AI Cooperation Toolbox Modernizing Defense Science and Technology Partnerships for the Digital Age”. 2021.

<sup>293</sup> Stanley-Lockman. 2021.

<sup>294</sup> Terri Cronk. “Hicks Announces New Artificial Intelligence Initiative”. *DOD News*, 2021

<sup>295</sup> Cronk. “Hicks Announces New Artificial Intelligence Initiative”. 2021.

<sup>296</sup> Ibid.

<sup>297</sup> Stanley-Lockman. 2021.

counties, to include Australia, Canada, Denmark, Estonia, Finland, France, Israel, Japan, Norway, the Republic of Korea, Sweden, and the United Kingdom to meet in partnership to discuss AI capabilities and Defense.<sup>298</sup> Kathleen Hicks, in her address, stated that China and Russia use aggressive artificial intelligent systems that challenge our norms. She elaborated how the U.S. wants AI to reflect America’s values, which include being responsible with AI and using ethical principles in our deployment of AI. Overall, China and Russia are challenging U.S. interests in the field of AI, and the U.S. is quickly mobilizing to remain at the top of AI capabilities while doing it an ethical way.

Overall, increased access to the global technology base is an important counterweight to the increasingly isolated innovation ecosystems of rivals, particularly given that there are more AI hubs in allied and partner countries than not.<sup>299</sup> Lastly, it is important to note that President Biden has continued many of former President Trump’s AI policies. AI innovation and regulation was one of the only sectors of government that President Biden adopted from the Trump Administration.

## Section 2: China’s AI Policy

### **Mission Statement:**

“To standardize internet information service algorithmic recommendation activities, safeguard national security and the social and public interest, protect the lawful rights and interests of citizens, legal persons, and other organizations, stimulate the healthy development of internet information services, and carry forward the socialist core value view of China”.<sup>300</sup>

### **Strategy:**

In order to harness the power of AI in today’s world, a country must have four inputs: abundant data, hungry entrepreneurs, AI scientists, and AI friendly policy. China checks the box for all four of these inputs and are looking to develop a strategy that allows them to surpass the United States in AI capabilities.<sup>301</sup>

China developed the New Generation Artificial Intelligence Development Plan in 2017. They have outlined three goals in their defined time horizon of about twelve years:

First, by 2020, the overall technology and application of AI will be in step with globally advanced levels, the AI industry will have become a new important economic growth point, and AI technology applications will have become a new way to improve people’s livelihoods, strongly supporting China’s entrance into the ranks of innovative nations and comprehensively achieving the struggle toward the goal of a moderately prosperous society.<sup>302</sup>

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<sup>298</sup> Cronk, 2021.

<sup>299</sup> Stanley-Lockman. 2021.

<sup>300</sup> “Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022”. *The People’s Republic of China* (Stanford Translated Edition), 2021

<sup>301</sup> Kai-Fu Lee. “AI Superpowers: China, Silicon Valley and the New World Order”. *Marinar Books*, 2018.

<sup>302</sup> “New Generational Artificial Intelligence Development Plan (Stanford Translation)”. *People’s Republic of China*. 2017.

Second, by 2025, China will achieve major breakthroughs in basic theories for AI, such that some technologies and applications achieve a world-leading level and AI becomes the main driving force for China's industrial upgrading and economic transformation, while intelligent social construction has made positive progress.<sup>303</sup>

Third, by 2030, China's AI theories, technologies, and applications should achieve world-leading levels, making China the world's primary AI innovation center, achieving visible results in intelligent economy and intelligent society applications, and laying an important foundation for becoming a leading innovation-style nation and an economic power.<sup>304</sup>

China's focused tasks as outlined in the New Generation Artificial Intelligence Development Plan include:

- 1.) Build open and coordinated AI science and technology innovation systems.
- 2.) Fostering a high-end, highly efficient smart economy.
- 3.) Construct a safe and convenient intelligent society.
- 4.) Strengthen military-civilian integration in the AI domain.
- 5.) Build a safe and efficient intelligent infrastructure system.
- 6.) Plan a new generation of AI major science and technology projects.

Additionally, in the primary and secondary schools, China plans to set up AI-related courses, and gradually promote programming education to encourage social forces to participate in the promotion and development of educational programming software and games.<sup>305</sup>

China will fully use all kinds of traditional media and new media to quickly propagate new progress and new achievements in AI, to let the healthy development of AI become a consensus in all of society and muster the vigor of all of society to participate in and support the development of AI. They will conduct timely public opinion guidance, and respond even better to social, theoretical, and legal challenges that may be brought about by the development of AI.<sup>306</sup>

Lastly, China is using an advanced triple helix strategy in their country to develop artificial intelligence. The original triple helix model in China is based on three basic elements:

- (1) the prominent role of universities in innovation, on par with companies and the government in a society based on knowledge.
- (2) the collaborative relationship between the three core institutional spheres.
- (3) the helices taking the roles of others.<sup>307</sup>

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<sup>303</sup> "New Generational Artificial Intelligence Development Plan (Stanford Translation)". 2017.

<sup>304</sup> Ibid.

<sup>305</sup> Ibid.

<sup>306</sup> Ibid.

<sup>307</sup> Alberto Arenal; Cristina Armuña; Claudio Feijoo; Sergio Ramos; Zimu Xu; Anna Moreno. "Innovation ecosystems theory revisited: The case of artificial intelligence in China". *Telecommunications Policy*; Vol. 44, ISS. 6, 2020.



However, China is now moving towards an advanced triple helix strategy to develop and promote AI in their country.

The advanced triple helix strategy encompasses venture capital (government-industry relationship), human capital (industry-universities relationship), knowledge production (universities-industry relationship), and data availability framework (government-industry relationship).<sup>308</sup>

Although China has a central government that sets the tone of AI development and regulation, they regionalize AI development and leave the execution of AI innovation and regulation to local leaders. China has 17 national-level innovation demonstration zones, which were selected by the State Council and enjoy dynamic policies to encourage innovation and regional economic growth.<sup>309</sup> China will continue to encourage competition among local zones to promote innovation.

### **Funding and Innovation:**

China states in their strategy that they plan to vigorously promote the construction of intelligent information infrastructure, enhance the traditional level of intelligent infrastructure to form a smart economy, and support the national defense needs of the infrastructure system.

For the development of China's AI needs and weak links, they plan to create a new generation of AI scientific and technological projects. China will strengthen the overall co-ordination, clear the boundaries of the tasks and the focus of research and development, and form a new generation of AI major scientific and technological projects as the core layout to support the "1 + N" AI program.<sup>310</sup>

"1" refers to a new generation of AI scientific and technological mega-projects, focusing on forward-looking layout for basic theories and key common technologies, including the study of big data intelligence, cross-media perception and computing, hybrid enhanced intelligence, group intelligence, autonomous collaborative control, and decision-making theory.<sup>311</sup>

"N" refers to the national planning and deployment of AI research and development projects. Focusing on strengthening the new generation of AI with the convergence major scientific and technological projects, collaborative impetus for research, technological breakthroughs, and product development applications.<sup>312</sup>

### **Regulation/Penalties:**

In China's Internet Information Service Algorithmic Recommendation Management Provisions, it states algorithmic recommendation service providers shall uphold mainstream value orientations, optimize algorithmic recommendation service mechanisms, vigorously disseminate

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<sup>308</sup> Arenal et al. "Innovation ecosystems theory revisited: The case of artificial intelligence in China". 2020.

<sup>309</sup> Arenal et al. 2020.

<sup>310</sup> "New Generational Artificial Intelligence Development Plan (Stanford Translation)". *People's Republic of China*. 2017.

<sup>311</sup> "New Generational Artificial Intelligence Development Plan (Stanford Translation)". 2017.

<sup>312</sup> Ibid.

positive energy, and advance the use of algorithms upwards and in the direction of good (People’s Republic of China, 2021). Algorithmic recommendation service providers may not use algorithmic recommendation services to engage in activities harming national security, upsetting the economic order and social order, infringing the lawful rights and interests of other persons, and other such acts prohibited by laws and administrative regulations.<sup>313</sup>

The PRC’s algorithmic recommendations also says where organizations or individuals conducting data handling activities do not perform the data security protection obligations the relevant departments in charge are to order corrections and give warnings and may also impose a fine of between 50,000 and 500,000 Yuan, and a fine of between 10,000 and 100,000 Yuan on directly responsible management personnel and other directly responsible personnel.<sup>314</sup>

China explicitly states where core national data management systems are violated, endangering national sovereignty, security, or development interests, relevant departments in charge are to impose a fine of between 2,000,000 and 10,000,000 Yuan. Where the provisions of Article 35 of this Law are violated through refusal to cooperate with the obtaining of data, the relevant departments in charge are to order correction, give warnings, impose a fine of between 50,000 and 500,000 Yuan, and fine directly responsible management personnel and other directly responsible personnel between 10,000 and 100,000 Yuan.<sup>315</sup>

Additionally, the Chinese national, provincial, autonomous region, and municipal cybersecurity and informatization departments, together with relevant competent departments, conduct algorithm security assessment and supervision and inspection work on algorithmic recommendation services, and promptly give suggestions to correct discovered problems and provide a time limit for rectification. The national or provincial, autonomous region, or municipal cybersecurity and informatization departments are to, based on their duties and responsibilities, issue a warning or a report of criticism, and order rectification within a limited time; where rectification is refused or circumstances are grave, they are to order provisional suspension of information updates, and impose a fine between 5,000 and 30,000 Yuan.<sup>316</sup>

### **Foreign Policy:**

Chinese military leaders are already prepared to employ and develop AI-related systems and equipment to prepare to “intelligentized” warfare.<sup>317</sup> It is likely that China has spent more than \$1.6 Billion each year in the past five years on the Chinese People’s Liberation Army (PLA) for AI related systems and equipment.<sup>318</sup> Chinese leaders view AI as a way to transform China into a

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<sup>313</sup> “Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022”. *The People’s Republic of China (Stanford Translated Edition)*, 2021.

<sup>314</sup> “Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022”. 2021.

<sup>315</sup> “Translation: Data Security Law of the People’s Republic of China (Stanford Translation). *People’s Republic of China (Stanford Translated Edition)*, Sep 2021.

<sup>316</sup> “Translation: Data Security Law of the People’s Republic of China (Stanford Translation). Sep 2021.

<sup>317</sup> Alex Stephenson and Ryan Fedasiuk. “How AI Would – And Wouldn’t – Factor into a U.S. – Chinese War”. *Texas National Security Review*, 2022.

<sup>318</sup> <sup>318</sup> Stephenson and Fedasiuk. “How AI Would – And Wouldn’t – Factor into a U.S. – Chinese War”. 2022.

world class globally competitive military force. PLA advancements in AI will create new vulnerabilities for the U.S. and other allied countries around the world.

Additionally, China’s military-civil fusion development strategy is helping the PLA acquire commercial-off-the-shelf technologies from private companies in China and other sources around the world.

The PLA is specifically adopting AI in these areas:

Intelligent and Autonomous Vehicles, Intelligence, Surveillance, and Reconnaissance (ISR), Predictive Maintenance and Logistics, Information and Electronic Warfare, Simulation and Training, Command and Control (C2), Automated Target Recognition.<sup>319</sup>

Overall, one of the PLA’s largest objectives is, to erode the U.S. advantage in undersea warfare and to jam U.S. sensor and communication networks. These aspirations are particularly relevant for U.S. policymakers and defense planners as they respond to mounting Chinese threats to Taiwan and other partners in the Indo-Pacific.<sup>320</sup>

PLA leaders frequently compare their own capabilities to those of the U.S. military, and public writings from 2021 refer explicitly to degrading and exploiting U.S. information systems. It is very clear that China has their sights set on challenging the United States military through the use of advanced AI.

## Section 3: Canada AI Policy

### **Mission Statement:**

“The Pan-Canadian AI Strategy strengthens Canada’s leadership in AI. CIFAR’s (The Canadian Institute for Advanced Research) leadership of the Pan-Canadian AI Strategy is funded by the Government of Canada, with support from Facebook and the RBC Foundation”. It is important to note that Canada was the first country to develop an AI policy in 2017.

Canada’s methods to accomplish this objective:

- Attract and retain world-class AI researchers by increasing the number of outstanding AI researchers and skilled graduates in Canada.
- Foster a collaborative AI ecosystem by establishing interconnected nodes of scientific excellence in Canada’s three major centers for AI: Edmonton, Montreal, and Toronto.
- Advance national AI initiatives by supporting a national research community on AI through training programs, workshops, and other collaborative opportunities.
- Understand the societal implications of AI by developing global thought leadership on the economic, ethical, policy, and legal implications of advances in AI.<sup>321</sup>

### **Strategy:**

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<sup>319</sup> Stephenson and Fedasiuk. 2022.

<sup>320</sup> Ibid.

<sup>321</sup> “The Pan-Canadian AI Strategy”. *CIFAR*, 2017.

In 2017, Canada created a Pan-Canadian AI Strategy and was the first country to establish an AI policy. Since then, Canadian provinces such as Ontario and Quebec, have created updated AI policy laws to improve strategies and regulations. Canada's original Pan-Canadian AI strategy has outlined several areas of focus in their AI strategy:

- Strengthen Canada's AI ecosystem: The Pan-Canadian AI Strategy's National Program of Activities includes training programs, task forces, grant programs, conferences, and more. These events bring AI researchers and trainees together from across the country and around the world to foster collaboration and advance AI.
- AI and Society: The AI & Society Program, one of the objectives of the CIFAR Pan-Canadian AI Strategy, develops global thought leadership on the economic, ethical, political, and legal implications of advances in AI. These dialogues deliver new ways of thinking about issues and drive positive change in the development and deployment of responsible AI.
- Canada's Leadership in AI: CIFAR's early leadership in AI was established as a result of the Learning in Machines & Brains program. In the 1980s, CIFAR launched a new AI research program called Artificial Intelligence, Robotics & Society, which included AI pioneer Geoffrey Hinton as one of its members. In 2004, he led the Neural Computation & Adaptive Perception Program, bringing computer and cognitive scientists together to develop a new approach to machine learning, inspired by the human brain. This program was renamed Learning in Machines & Brains in 2014. Under the co-direction of Yoshua Bengio and Yann LeCun, it continues to advance AI research.

Canada CIFAR AI Chairs: The Canada CIFAR AI Chairs program is the cornerstone of the CIFAR Pan-Canadian AI Strategy. A total of \$86.5 million has been earmarked for this program. Its goal is to recruit the world's leading AI researchers to Canada, while retaining our existing top talent. The program provides long-term, dedicated research funding to support their research programs and help them train the next generation of AI leaders.<sup>322</sup>

There are 109 Canada CIFAR AI Chairs advancing research in a range of fundamental and applied AI topics from drug discovery and machine learning for health, autonomous vehicles, materials discovery, human-AI interaction, natural language prediction, and more.<sup>323</sup>

### **Funding and Innovation:**

In 2017, the Canadian Government appointed CIFAR to develop and lead a \$125 million Pan-Canadian Artificial Intelligence Strategy, the world's first national AI strategy. Canada continues to fund three national AI Institutes — Amii in Edmonton, Mila in Montreal, and the Vector Institute in Toronto, as well as universities, hospitals, and organizations across the country. Canada's main strategy to develop innovation is through three hubs, Edmonton, Montreal, and Toronto.<sup>324</sup>

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<sup>322</sup> "The Pan-Canadian AI Strategy". 2017.

<sup>323</sup> Ibid.

<sup>324</sup> Ibid.

## Regulation/Penalties:

Canada has established four committees to ensure ethical use of AI. These four committees are:

- AI advisory council: Announced on May 14, 2019, the Advisory Council on Artificial Intelligence will advise the Government of Canada on building Canada's strengths and global leadership in AI, identifying opportunities to create economic growth that benefits all Canadians and ensuring that AI advancements reflect Canadians' values.
- Canada's Digital Charter: The Charter lists ten principles that demonstrate how the Government of Canada is working with Canadian companies to ensure the privacy of Canadians is protected and their data kept safe.
- Standards Council of Canada Canadian Data Governance Standardization Collaborative: The collaborative launched on May 30, 2019, with the mission of building a comprehensive roadmap of needed data governance standards to help industry and citizens benefit from the growing supply of data, as well as manage security and privacy risks.
- CIO Strategy Council: The Council's mandate is to provide a forum for Canada's most forward-thinking Chief Information Officers to focus on collectively transforming, shaping, and influencing the Canadian and information technology ecosystem. The Council is leading the development of standards for the use and application of AI-based decision-making systems.

Canada currently has a voluntary system; therefore, companies and individuals are not bound to Canadian laws.<sup>325</sup>

Since 2017, Canada has made regional adjustments to improve their AI policy. In 2021, Ontario developed a "Trustworthy Artificial Intelligence" to "support AI use that is accountable, safe, and rights based".<sup>326</sup> This piece of legislation emphasizes risk mitigation, human rights, and transparency.

Additionally in 2021, Quebec National Assembly adopted the report of the Committee on Institutions (the "Committee") on the Act to Modernize Legislative Provisions respecting the Protection of Personal Information ("Bill 64") with its amendments (Morgan, 2021). Bill 64 represents a major privacy regime reform aimed at improving transparency, increasing the level of data confidentiality, and reinforcing consent requirements. Bill 64 will bring many changes to the current privacy regime in the province of Quebec and lead the privacy law reform movement in Canada.<sup>327</sup> This has not been enacted into law yet; however, it is expected to pass soon. Canada took a more regionalized approach in their innovation through the establishment of "innovation hubs". They are doing the same with their regulation now as well.

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<sup>325</sup> Ibid.

<sup>326</sup> "Consultation: Ontario's Trustworthy Artificial Intelligence (AI) Framework". *Government of Ontario*, 2021.

<sup>327</sup> Morgan, Charles; Joizil, Karine; Chen, Ellen; Langlois, Francis; Roy, Janie. "Bill 64 Committee Report Adopted by Québec National Assembly". *McCarthy Tetrault*, 2021.

### Foreign Policy:

Canada's artificial intelligence policy does not have a specific foreign policy; however, they do want to bring foreign talent into Canada to promote growth and innovation. Canada is aiming to attract foreign talent to their innovation hubs at Toronto, Edmonton, and Montreal.

## Section 4: The European Union AI Policy

### Mission Statement:

“To ensure that AI systems placed on the European Union market are safe and respect existing law on fundamental rights and Union values; ensure legal certainty to facilitate investment and innovation in AI; enhance governance and effective enforcement of existing law on fundamental rights and safety requirements applicable to AI systems; to facilitate the development of a single market for lawful, safe and trustworthy AI applications and prevent market fragmentation.”<sup>328</sup>

### Strategy:

In 2021, the European Union drafted the EU Artificial Intelligence Act. The EU Artificial Intelligence act is still in the process of becoming an official law; however, it is expected to pass legislation. If passed, the EU's Artificial Intelligence Act will be the most comprehensive and regulatory AI framework in the world. The following strategies are assuming the EU Artificial Intelligence Act becomes law.

The EU has proposed a regulatory framework for high-risk AI systems only, with the possibility for all providers of non-high-risk AI systems to follow a code of conduct. The requirements will concern data, documentation and traceability, provision of information and transparency, human oversight and robustness and accuracy and would be mandatory for high-risk AI systems.<sup>329</sup>

The EU has stated that it is necessary to prohibit certain artificial intelligence practices, to lay down requirements for high-risk AI systems and obligations for the relevant operators, and to lay down transparency obligations for certain AI systems. High-risk AI systems have the intention to materially distort the behavior of a person and in a manner that causes or is likely to cause harm to that or another person.<sup>330</sup>

To follow, the EU stated that such high-risk practices are particularly harmful and should be prohibited because they contradict Union values of respect for human dignity, freedom, equality, democracy and the rule of law and Union fundamental rights, including the right to non-discrimination, data protection and privacy and the rights of the child.<sup>331</sup>

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<sup>328</sup> “A Proposal for a Regulation of The European Parliament and of the Council. Laying Down Harmonized Rules on Artificial Intelligence and Amending Certain Union Legislative Acts.” *European Commission*. Brussels, 2021.

<sup>329</sup> “A Proposal for a Regulation of The European Parliament and of the Council. Laying Down Harmonized Rules on Artificial Intelligence and Amending Certain Union Legislative Acts.” 2021.

<sup>330</sup> *Ibid.*

<sup>331</sup> *Ibid.*

## Funding and Innovation

The EU Artificial Intelligence Act has appropriated funding that amounts to at least \$1 billion USD per year for AI research and over \$5 billion USD in other areas of their AI development (European Commission, 2021). With that being said, each individual country within the EU has the ability to develop its own funding strategy to promote AI within their own country.<sup>332</sup> Therefore, the EU takes more of a role in the regulation of AI rather than the funding and innovation.

## Regulations and Penalties

The EU has stated that High-risk AI systems shall be tested for the purposes of identifying the most appropriate risk management measures. Testing shall ensure that high-risk AI systems perform consistently for their intended purpose, and they follow the requirements set out by the EU. The EU will also test the data and governance that a given AI system uses to ensure it follows the regulation. A high-risk AI system must also have technical documentation and record keeping ensuring that it does not violate the regulation.<sup>333</sup>

To follow, the commission states that providers of AI systems will be held accountable for the systems they emplace. Providers of high-risk AI systems shall have a quality management system in place, draw-up the technical documentation of the high-risk AI system, ensure that the high-risk AI system undergoes the relevant conformity assessment procedure, and inform the national competent authorities of the Member States in which they made the AI system available or put it into service.<sup>334</sup>

If an offender violates the established rules and regulations, they shall be subject to administrative fines of up to 30,000,000 EUR or, if the offender is a company, up to 6 % of its total worldwide annual turnover for the preceding financial year, whichever is higher.<sup>335</sup>

In the European Union, the non-compliance of the AI system with any requirements or obligations under this Regulation, other than those laid down in Articles 5 and 10, shall be subject to administrative fines of up to 20,000,000 EUR or, if the offender is a company, up to 4 % of its total worldwide annual turnover for the preceding financial year, whichever is higher.<sup>336</sup>

It is important to note the EU's AI Act was drafted in early 2021. During the time of legislation, foundation models were not a relevant part of the picture in the field of artificial intelligence. The idea and beginnings of foundation models existed; however, no significant models were in use. By the end of 2022, foundation models have emerged as a significant part of the AI landscape and are much different than traditional AI models (See more on foundation models in chapter 5). Europe's original AI Act did not address foundation models. Europe has coined these

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<sup>332</sup> Ibid.

<sup>333</sup> Ibid.

<sup>334</sup> Ibid.

<sup>335</sup> Ibid.

<sup>336</sup> Ibid.

models as General-Purpose Artificial Intelligence Systems, or “GPAIS”.<sup>337</sup> Europe is has had to make constant revisions to their AI policy (like renaming AI systems and adding new ones) due to its extensive regulatory framework in a fast-moving field like artificial intelligence.

## Section 5: The United Kingdom

### **Mission Statement:**

“The UK’s National AI Strategy aims to invest and plan for the long-term needs of the AI ecosystem to continue our leadership as a science and AI superpower; support the transition to an AI-enabled economy, capture the benefits of innovation in the UK, and ensure AI benefits all sectors and regions; ensure the UK gets the national and international governance of AI technologies right to encourage innovation, investment, and protect the public and our fundamental values”.<sup>338</sup>

### **Strategy**

In 2021, the United Kingdom developed their “National AI Strategy” legislation. The UK is setting their AI policy time frame to be 10 years. The UK believes they have an opportunity over the next ten years to position itself as the best place to work in the field of AI; with clear rules, applied ethical principles and a pro-innovation regulatory environment. With the right ingredients in place, the UK believes they will be both a genuine innovation powerhouse and the most supportive business environment in the world, where they will cooperate on using AI for good, advocate for international standards that reflect their values, and defend against the malign use of AI.<sup>339</sup>

The UK has three core AI pillars.

Pillar 1: Investing in the long-term needs of the AI ecosystem.

Pillar 2: Ensuring AI benefits all sectors and regions.

Pillar 3: Governing AI effectively

The UK is also stressing the importance of diversity in AI ecosystem for moral, social, and economic reasons.<sup>340</sup>

### **Funding and Innovation:**

In the United Kingdom’s National AI Strategy, the UK government has appropriated more than £2.3 billion funds into artificial intelligence across a range of initiatives since 2014. This portfolio of investment includes, but is not limited to:

- £250 million to develop the NHS AI Lab to accelerate the safe adoption of Artificial Intelligence in health and care.

<sup>337</sup> Carlos Gutierrez, Anthony Aquirre; Risto Uuk, Claire Boine Matija Franklin. “A Proposal for a Definition of General-Purpose Artificial Intelligence Systems”. *SSRN*, 2022.

<sup>338</sup> “National AI Strategy”. *Parliament of the United Kingdom*, Sep. 2021.

<sup>339</sup> “National AI Strategy”. *Parliament of the United Kingdom*, 2021.

<sup>340</sup> “National AI Strategy”. 2021.



- £250 million into connected and autonomous mobility (CAM) technology through the Centre for Connected and Autonomous Vehicles (CCAV) to develop the future of mobility in the UK.
- 16 new AI centers for doctoral training at universities across the country, backed by up to £100 million and delivering 1,000 new PhDs over five years.
- A new industry-funded AI master's program and up to 2,500 places for AI and data science conversion courses. This includes up to 1,000 government-funded scholarships.
- Investment into The Alan Turing Institute and over £46 million to support the Turing AI Fellowships to develop the next generation of top AI talent.
- Over £372 million of investment into UK AI companies through the British Business Bank for the growing AI sector.
- £172 million of investment through the UKRI into the Hartree National Centre for Digital Innovation, leveraging an additional £38 million of private investment into high performance computing.<sup>341</sup>

With the money the UK has funded into the field of AI, here is how they plan to drive innovation:

1. Launch a new National AI Research and innovation programs that will align funding programs across UKRI Research Councils and innovate UK, stimulating new investment in fundamental AI research while making critical mass investments in particular applications of AI.
2. Lead the global conversation on AI R&D and put AI at the heart of our science and technology alliances and partnerships worldwide through:
3. Develop a diverse and talented workforce which is at the core of maintaining the UK's world
4. Publish a policy framework setting the government's role in enabling better data availability in the wider economy. The government is already consulting on the opportunity for data intermediaries to support responsible data sharing and data stewardship in the economy and the interplay of AI technologies with the UK's data rights regime.
5. Consult on the potential role and options for a future national 'cyber-physical infrastructure' framework, to help identify how common interoperable digital tools and platforms and living labs could come together to form a digital and physical 'commons' for innovators, enabling accelerated AI development and applications.
6. Publish a report on the UK's compute capacity needs to support AI innovation, commercialization, and deployment. The report will feed UKRI's wider work on infrastructure.
7. Continue to publish open and machine-readable data on which AI models for both public and commercial benefit can depend.
8. Consider what valuable datasets the government should purposefully incentivize or curate that will accelerate the development of valuable AI applications.

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<sup>341</sup> Ibid.

9. Undertake a wider review of our international and domestic approach to the semiconductor sector. Given commercial and innovation priorities in AI, further support for the chip design community will be considered.

10. Evaluate the state of funding specifically for innovative firms developing AI technologies in the UK, and report on this work in Autumn 2022.<sup>342</sup>

### **Regulation/Penalties:**

There are currently no extensive regulations in the field of artificial intelligence for the United Kingdom. However, the government issued a paper called “a pro-innovation approach to regulating AI” in July of 2022 that outlines how AI regulations are built on four pillars that includes pro innovation, light touch, coherence, and proportionality.<sup>343</sup>

### **Foreign Policy:**

The United Kingdom has stated that there are also risks, safety, and national security concerns that must be considered on a consistent basis from deepfakes and targeted misinformation from authoritarian regimes to sophisticated attacks on consumers or critical infrastructure. As AI becomes increasingly ubiquitous, it has the potential to bring risks into everyday life, into businesses and into national security and defense. As AI becomes more general and is simply used in more domains, the UK states they must maintain a broad perspective on implications and threats, with the tools to understand its most subtle impacts, and ensure the UK is protected from bad actors using AI, as well as risks inherent in unsafe future versions of the technology itself.<sup>344</sup>

The UK will protect national security through the National Security & Investment Act while keeping the UK open for business with the rest of the world, as their economy’s success and citizens’ safety rely on the government’s ability to take swift and decisive action against potentially hostile foreign investment.<sup>345</sup>

The UK will include provisions on emerging digital technologies, including AI, in future trade deals alongside championing international data flows, preventing unjustified barriers to data crossing borders and maintaining the UK’s high standards for personal data protection.

## Section 6: France AI Policy

### **Mission Statement:**

“Artificial intelligence often sounds like a promise for the future, but we must not fool ourselves: this revolution is happening here and now. This radical transformation is both an unprecedented opportunity and an immense responsibility. We have to fully seize the opportunities offered by

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<sup>342</sup> Ibid.

<sup>343</sup> Keith Chan et al. “Balancing the Tradeoff between Regulation and Innovation for Artificial Intelligence: An Analysis of Top-down Command and Control and Bottom-up Self-Regulatory Approaches”. *The Hong Kong University of Science and Technology*, 2022.

<sup>344</sup> “National AI Strategy”. *Parliament of the United Kingdom*, 2021.

<sup>345</sup> “National AI Strategy”. 2021.

artificial intelligence now, while designing the framework to regulate it. That is the ambition of the President, and he is committed to:

1. Bet on French talent.
2. Pool our assets.
3. Establish ethical framework.<sup>346</sup>

### **Strategy:**

In 2018, France developed their “AI for Humanity” AI policy that outlines their AI policy strategy.

France is developing an aggressive data policy strategy that:

- Encourages companies to pool and share their data.
- Creates data that is in the public interest.
- Supports the right to data portability (making personal data available to the French government).

France also is developing four strategic areas:

1. Areas in which France and Europe will excel.
2. Areas that represent important challenges in terms of the public interest.
3. Areas that attract the interest and involvement of public and private actors.
4. Areas require strong public leadership to trigger transformations.<sup>347</sup>

### **Funding and Innovation:**

The French are focusing on innovating in these four fields:

- Health Field
- Transportation Field
- Defense and Security
- Environmental Field

The French are boosting their potential research in the field of AI

Their research initiatives include:

- Create interdisciplinary AI institutes (3IA) in selected public higher education and research establishments. These institutes must be spread throughout France and cover a specific application or field of research.
- Allocate appropriate resources to research, including a supercomputer designed especially for AI applications in partnership with manufacturers. In addition, researchers must be given facilitated access to a European cloud service.

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<sup>346</sup> “AI For Humanity”. *Parliament of France*, 2018.

<sup>347</sup> “AI For Humanity”. 2018.

- Make careers in public research more attractive by boosting France’s appeal to expatriate or foreign talents: increasing the number of masters and doctoral students studying AI, increasing the salaries of researchers, and enhancing exchanges between academics and industry.<sup>348</sup>

### **Regulation/Penalties:**

France is concerned with data clarity and data accessibility. The French AI policy states:

“In the long term, artificial intelligence technologies must be explainable if they are to be socially acceptable. For this reason, the government must take several steps:

1. Develop algorithm transparency and audits
2. Consider the responsibility of AI actors for the ethical issues at stake
3. Create a consultative ethics committee for digital technologies and AI, which would organize public debate in this field. This committee would have a high level of expertise and independence. Indeed, 94% of those interviewed considered that the development of AI in our society should be regularly addressed in public debates.
4. Guarantee the principle of human responsibility, particularly when AI tools are used in public services. This includes setting boundaries for the use of predictive algorithms in the law enforcement context. It also means extensively discussing any development of lethal autonomous weapons systems (LAWS) at the international level and creating an observatory for the non-proliferation of these weapons”<sup>349</sup>

They do not fine French companies or individuals who break their laws because the EU already has a framework to enforce those laws.

### **Foreign Policy:**

The French state that AI research is the focus of fierce international competition particularly between the United States and China.<sup>350</sup>

## Section 7: Netherlands AI Policy

### **Mission Statement:**

“If the Netherlands and Europe wish to be at the forefront of a globally competitive economy, we must accelerate the development and application of AI in the Netherlands. We can do so. The Netherlands is well positioned to take on this challenge, partly due to its high-quality connectivity, strong foundation for public-private partnerships (PPP) and world-class research. We must make good use of this head start to develop our international profile in this area.”<sup>351</sup>

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<sup>348</sup> Ibid.

<sup>349</sup> Ibid.

<sup>350</sup> Ibid.

<sup>351</sup> “Strategic Action Plan for Artificial Intelligence”. *Ministry of the Netherlands*, 2019.

## Strategy

In 2019, The Netherlands established their AI policy, titled “Strategic Action Plan for Artificial Intelligence”.

The Dutch government is focused on three tracks:

### 1. Capitalizing on Societal and Economic Opportunities

AI offers great societal and economic opportunities. First, there are opportunities for solving societal challenges in which the government is involved as a partner. Consider, for example, the use of AI for more effective investigation and enforcement, new possibilities for prevention, diagnosis and treatment in healthcare, cultivation of crops without daylight, and predicting traffic jams. AI also has considerable potential in the provision of public services and can help improve work processes of government organizations. The government is also encouraging the business community to develop AI applications and utilize knowledge.

### 2. Creating the Right Conditions:

In order to accelerate AI development, the government wants the Netherlands to have a vibrant AI climate with conditions that support and promote AI research and the development, marketing, and deployment of AI applications. This requires a number of key ingredients: high-quality research and innovation, a workforce with the right knowledge and skills to develop and work with AI, access to sufficient high-quality data, and high-quality and intelligent digital connectivity. Given its aim to boost AI developments in the Netherlands, the government is fully committed to achieving these conditions.

### 3. Strengthen the foundations.

The foundations need to be strengthened in order to be able to take advantage of the opportunities offered by AI and address the risks. In this context, the government is committed to the protection of citizens’ fundamental rights and to appropriate ethical and legal frameworks. This allows people and companies to maintain trust in AI. It is also of fundamental importance that markets remain open and competitive, and that national security is safeguarded in the AI developments.<sup>352</sup>

## Funding and Innovation:

The Netherlands state they will need to accelerate in the area of AI, as it is crucial for the efficiency and effectiveness of all sectors and domains. Other countries are also investing heavily in AI, for good reasons. The Netherlands must facilitate AI, so that companies can keep their research and innovation in (and bring it to) the Netherlands.<sup>353</sup>

## Regulation/Penalties:

The Dutch have no fines or penalties in place because the European Union has already established their regulatory guidelines. Instead, the Dutch Strategic Action Plan for AI is an

<sup>352</sup> “Strategic Action Plan for Artificial Intelligence”. 2019.

<sup>353</sup> Ibid.

agenda that is updated annually. The House of Representatives will be informed about the implementation of the policy actions set out in this action plan as part of the progress report and update of the Dutch Digitalization Strategy. In addition, the various ministries apply their own evaluation and monitoring systems for the actions for which they are responsible. The progress of the AI approach is on the agenda of the National Council for the Dutch Digitalization Strategy.<sup>354</sup>

### **Foreign Policy:**

The Netherlands will attempt to lead the European Union in AI innovation. This Strategic Action Plan for AI (SAPAI) contains the government's intentions to accelerate AI development in the Netherlands and to raise its profile internationally. It examines AI developments in the Netherlands, the elements needed to further encourage AI innovation, and the fundamentals that are crucial to safeguarding public interests in AI developments.<sup>355</sup>

## Section 8: Russia AI Policy

**\*\*\* Note that these were Russia's objectives and strategies before they invaded Ukraine. Their AI policy has taken a back seat as they are focused on their war effort. I debated to not include Russia in order to not give them any attention; however, their AI policy will have significant impacts in the future and needs to be understood.**

### **Mission Statement:**

“The Russian Federation has significant potential to become one of the international leaders in the development and use of artificial intelligence technologies. At the same time, a few leading participants in the global artificial intelligence market are taking active steps to ensure their dominance in this market and gain long-term competitive advantages, creating significant barriers to the achievement of competitive positions by other market participants”.<sup>356</sup>

### **Strategy**

The Kremlin declared their decree, called “Decree of the President of the Russian Federation on the Development of Artificial Intelligence in the Russian Federation” that established their AI Policy in 2019.

The provisions of the Russian strategy shall be considered in the implementation of the following documents:

a) Strategy for the Development of the Information Society in the Russian Federation for 2017-2030.

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<sup>354</sup> Ibid.

<sup>355</sup> Ibid.

<sup>356</sup> “Decree of the President of the Russian Federation On the Development of Artificial Intelligence in the Russian Federation”. *The Kremlin*, 2019.

b) the National program "Digital Economy of the Russian Federation" and other national projects (programs), federal and regional projects, within the framework of which it is possible to use artificial intelligence technologies.

c) Action plans ("road maps") of the National Technology Initiative.

d) State programs, program-target documents, the effectiveness of the implementation of which can be increased through the use of artificial intelligence technologies.

e) Projects that ensure the achievement of goals and performance indicators of federal executive bodies.<sup>357</sup>

### **Funding and Innovation:**

Russia plans to innovate AI by creating conditions for improving efficiency and the formation of fundamentally new areas of activity of economic entities, including through:

(a) Improving the efficiency of planning, forecasting and management decision-making processes (including forecasting equipment failures and preventive maintenance, optimizing supply planning, production processes and financial decision-making).

b) Automation of routine (repetitive) production operations.

c) The use of autonomous intelligent equipment and robotic complexes, intelligent logistics management systems.

d) Improving the safety of employees in the implementation of business processes (including forecasting risks and adverse events, reducing the level of direct human participation in processes associated with an increased risk to his life and health).

e) Increasing customer loyalty and satisfaction (including sending them personalized offers and recommendations containing essential information).

(e) Optimization of recruitment and training processes, preparation of an optimal work schedule for employees, considering various factors.<sup>358</sup>

### **Regulation/Penalties:**

Russia has created a non-voluntary regulatory system. The Kremlin states that companies and individuals must follow these basic values:

The main principles for the development and use of artificial intelligence technologies, compliance with which is mandatory in the implementation of this strategy, are:

a) Protection of human rights and freedoms: ensuring the protection of human rights and freedoms guaranteed by Russian and international legislation, including the right to work, and

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<sup>357</sup> "Decree of the President of the Russian Federation On the Development of Artificial Intelligence in the Russian Federation". 2019.

<sup>358</sup> Ibid.



providing citizens with the opportunity to gain knowledge and acquire skills for successful adaptation to the conditions of the digital economy.

b) Safety: the inadmissibility of using artificial intelligence for the purpose of intentionally causing harm to citizens and legal entities, as well as preventing and minimizing the risks of negative consequences of the use of artificial intelligence technologies.

c) Transparency: explainability of the work of artificial intelligence and the process of achieving its results, non-discriminatory access of users of products that are created using artificial intelligence technologies to information about the algorithms used in these products.

d) Technological sovereignty: ensuring the necessary level of independence of the Russian Federation in the field of artificial intelligence, including through the preferential use of domestic artificial intelligence technologies and technological solutions developed based on artificial intelligence.<sup>359</sup>

### **Foreign Policy:**

Russia has stated that the implementation of this strategy, considering the current situation in the global artificial intelligence market and medium-term forecasts for its development, is a necessary condition for the entry of the Russian Federation into the group of world leaders in the development and implementation of artificial intelligence technologies and, as a result, the technological independence and competitiveness of the country.

The Russians highlight that few leading participants in the global artificial intelligence market are taking active steps to ensure their dominance in this market and gain long-term competitive advantages, creating significant barriers to the achievement of competitive positions by other market participants.<sup>360</sup>

As stated above, the Russia-Ukraine war has significantly slowed down AI production in Russia. Russia benefited from many western suppliers of technology, innovation, and ideas that are no longer existent.<sup>361</sup> Russia is focused on the wartime effort in Ukraine, and not necessarily developing artificial intelligence, especially if it does not have any battlefield implications.

## Section 9: Japan AI Policy

### **Mission Statement:**

“In Japan, high-quality data has been utilized to improve productivity at Monozukuri manufacturing sites since the past. Sectors such as arts and culture that Japan has cultivated over long periods of time contain contents that can be boasted to the world. It is necessary to integrate such strengths of Japan with AI technology, and to link this to strengthening industrial competitive strength.”<sup>362</sup>

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<sup>359</sup> Ibid.

<sup>360</sup> Ibid.

<sup>361</sup> Fink, Anya. “Impacts Of the Ukraine War On Russian Technology Development”. *CAN*, 2022.

<sup>362</sup> “Artificial Intelligence Technology Strategy (Report of Strategic Council for AI Technology)”. *Japan Strategic Council for AI Technology*, Mar 2021.

**Strategy:**

In 2021 Japan developed a comprehensive AI Policy, “Artificial Intelligence Technology Strategy” that drives Japanese AI policy.

Japan is using a three-phase method to develop and expand their AI capabilities. It seems that Japan is using a lean six sigma approach to cultivate AI innovation. The three phases of AI development and expansion include:

Phase 1: Utilization and application of data-driven AI developed in various domains.

Phase 2: Public use of AI and data developed across various domains.

Phase 3: Ecosystem built by connecting multiplying domains.<sup>363</sup>

**Funding and Innovation:**

Rather than funding different programs, Japan plans to use start-ups and universities to promote innovation in AI. The promotion of R&D projects based on industry-academia-government collaboration. They state that it is necessary to carry out environmental development and utilize data that is linked to social needs, such as in the sectors of health, medical care, welfare, transportation, agriculture, forestry, and fisheries. To do so, it is also necessary for the three centers to coordinate with relevant ministries.<sup>364</sup>

**Regulation/Penalties:**

Japan emphasizes that data is an essential technical development of AI Technology. Japan plans to regulate their data with no penalties as of now.

**Foreign Policy:**

Japan does not state an explicit foreign policy; however, they do acknowledge that they are behind both the United States and China and need to attempt to catch up.<sup>365</sup>

## Section 10: Australia AI Policy

**Mission Statement:**

“No one country will drive or decide how the forthcoming AI transformation happens – it will be a global effort. The question is how we can best position our nation to adapt and capitalize on these changes for the benefit of all Australians”.<sup>366</sup>

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<sup>363</sup> “Artificial Intelligence Technology Strategy (Report of Strategic Council for AI Technology)”. Mar 2021.

<sup>364</sup> Ibid.

<sup>365</sup> Ibid.

<sup>366</sup> “Artificial Intelligence: Solving Problems, Growing the Economy, and Improving our Quality of Life”. *Australian Parliament*, 2020

**Strategy:**

In 2020, Australia developed their AI strategy, titled “Artificial Intelligence: Solving Problems, Growing the Economy, and Improving our Quality of life” to outline their national AI strategy.

The Australians have set out specific strategies in their AI policy. Australia is specializing in areas to develop their AI. These specific sectors include agriculture, helping small businesses run their enterprise, and helping people with diseases and medical needs using AI.<sup>367</sup>

**Funding and Innovation:**

In 2018, Australia announced a \$29.9 million project to advance AI and machine learning, along with development of an AI strategy. The central government also used these funds to create more PHD scholarships in the field of AI.

In later months, the Australian government announced a \$19 million initiative on AI and machine learning to target AI driven solutions for areas including food security, quality health and wellbeing, and sustainable energy resources (Australian Parliament 2020).

Since 2010, the Australian Research Council has awarded over \$243 million on pure research projects classified as AI and image processing.<sup>368</sup>

**Regulation/Penalties:**

Australia has a voluntary system that focuses on cybersecurity, standards, interoperability, and ethics. Australia is focusing on building trustworthy AI and connecting to citizens. They do not fine their companies or individuals for breaking these laws.<sup>369</sup>

**Foreign Policy:**

Australia is taking a different approach than most countries and is looking to export their AI to other countries. The global food system will be expected to increase production by as much as 35% by 2030 and Australia is looking to export AI services to help meet this demand.<sup>370</sup>

## Section 11: India AI Policy

**Strategy:**

NITI Aayog (the premier policy think tank of the government of India) established their national AI policy in 2018, called “National Strategy on Artificial Intelligence”.

India is taking a three-pronged approach - undertaking exploratory proof-of-concept AI projects in various areas, crafting a national strategy for building a vibrant AI ecosystem in India and collaborating with various experts and stakeholders. Since the start of this year, NITI Aayog has partnered with several leading AI technology players to implement AI projects in critical areas

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<sup>367</sup> “Artificial Intelligence: Solving Problems, Growing the Economy, and Improving our Quality of Life”. 2020

<sup>368</sup> Ibid.

<sup>369</sup> Ibid.

<sup>370</sup> Ibid.

such as agriculture and health. Their focus is on sectors like agriculture, health and education where public investment and lead would be necessary.<sup>371</sup>

### **Funding and Innovation**

The Indian Strategy focuses on economic growth through startups and government guidance. They are promoting social inclusion and addressing biased issues.

In 2020, India funded \$949 million into AI development. In 2019, the Ministry of Electronics and Information Technology released its own proposal to set up a national AI program with an allocated INR 400 crore (USD 54 million). The Indian government formed a committee in late 2019 to push for an organized AI policy and establish the precise functions of government agencies to further India's AI mission.<sup>372</sup>

### **Regulations/Penalties**

Currently, India does not have an overarching guidance framework for the use of AI systems. Establishing such a framework would be crucial for providing guidance to various stakeholders in responsible management of Artificial Intelligence in India. There are certain sector specific frameworks that have been identified for development and use of AI.<sup>373</sup>

In finance, SEBI issued a circular in January 2019 to stockbrokers, depository participants, recognized stock exchanges, and depositories and in May 2019 to all mutual funds (MFs)/ asset management companies, and board of trustees of mutual funds on reporting requirements for Artificial Intelligence (AI) and Machine Learning (ML) applications and systems offered and used.<sup>374</sup>

The reporting is towards creating an inventory of AI systems in the market and guiding future policies. The strategy for National Digital Health Mission (NDHM) identifies the need for creation of guidance and standards to ensure reliability of AI systems in health.<sup>50</sup> The Data Empowerment and Protection Architecture (DEPA) by NITI Aayog presents a technical framework for people to retain control of their personal data, and the means to leverage it to avail services and benefits.<sup>375</sup>

India currently does not have overarching legislation specific to AI. The closest to this is the draft Personal Data Protection Bill (2019) (PDP) designed as comprehensive legislation outlining various facets of privacy protections that AI solutions need to comply with. It covers limitations on data processing, security safeguards to protect against data breaches and the provision of special provisions relating to vulnerable users such as children.<sup>376</sup>

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<sup>371</sup> "National Strategy on Artificial Intelligence". *NITI Aayog*, 2018.

<sup>372</sup> "Artificial Intelligence Index Report, 2021 – Chapter 4: Education". *Stanford*, 2022.

<sup>373</sup> "National Strategy on Artificial Intelligence". *NITI Aayog*, 2018.

<sup>374</sup> "National Strategy on Artificial Intelligence". 2018.

<sup>375</sup> *Ibid.*

<sup>376</sup> *Ibid.*

## Section 12: United Arab Emirates AI Policy

### **Mission Statement:**

“To transform the UAE into a world leader in AI by investing in the people and industries that are key to the UAE’s success”.<sup>377</sup>

### **Strategy**

The United Arab Emirates developed one of the most aggressive AI policies in the world titled, “UAE National Strategy for Artificial Intelligence 2031” in 2019.<sup>378</sup>

The UAE will begin through its Existing Strengths:

#### 1.) Industry Assets & Emerging Sectors

The UAE has set priority sectors – these will be the focus of initial activities.

Resources & Energy: from existing technology in the extraction industry to renewable energy and innovation in utilities.

Logistics & Transport: longstanding air and sea hubs in the UAE make it a valuable location for piloting new systems in the sector.

Tourism & Hospitality: opportunity for globally becoming first in customer support AI, creating integrated and personalized services for tourists in the UAE.

#### 2.) Smart Government:

The UAE is already taking steps to apply AI in innovative way across government dynamically adjusting transport timetables to respond to incidents, using AI sensors for smart traffic, deploying facial recognition to monitor driver fatigue and introducing chatbots to improve customer service.

#### 3.) Data Sharing and Governance

It is part of the UAE’s ethos to turn ambitious visions into deliverable projects. This connection between big ideas and practical implementation will become an asset in AI policy discussions, that can fall easily into abstract or implausible science fiction. Combining hands-on experience with new technologies and global policy development is a strong way to develop a plausible, positive future for AI.

#### 4.) New Generation of Regional Talent

The UAE offers access to world-leading universities and a safe hub for highly skilled professionals to re-skill the most in-demand AI roles. The country needs to leverage on its geographic position, and this existing cohort of talent around it.<sup>379</sup>

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<sup>377</sup> “UAE National Strategy for Artificial Intelligence 2031”. *United Arab Emirates Minister of State for Artificial Intelligence, Digital Economy, and Remote Work Application Office*, 2019.

<sup>378</sup> “UAE National Strategy for Artificial Intelligence 2031”. 2019.

<sup>379</sup> Ibid.

## Funding and Innovation

The UAE are innovating in their respective countries in many different ways, and they are actively trying to recruit the best talent to the UAE through their UAE AI seal program. The UAE is developing a UAE AI Seal [UAI] brand and will use this to attract talent and business from across the globe to come to the UAE to test and develop AI. This includes a UAI mark recognizing high quality, ethical AI companies. It would reward safe, efficient, verified AI technology with a 'UAI Seal of Approval'.<sup>380</sup>

The UAE president stated that in order to encourage more research, collaboration and commercialization local expertise will be aggregated through the establishment of a network of researchers, industry experts and policy experts from across the UAE. Funding for AI research and companies could be provided according to priorities identified by the group, backed by evidence from a survey of regional AI activities.

The Mohammed bin Rashid Innovation Fund has AED 2 billion to support local innovators. Collaboration between the fund and the UAE Artificial Intelligence and Blockchain Council could support companies that need access to government data or partnerships with Government.

The UAE will develop incentives will be developed to encourage UAE firms to partner with global AI technology firms to foster greater links into global value chains and enable technology transfer from international firms. The incentives will also motivate international companies to set up regional offices in the UAE or relocate here. For example, a new cyber research center in Stuttgart and Tubingen, Germany (the Max Planck Society's Institute for Intelligence Systems) attracted foreign investment from Amazon leading to an estimated 100 jobs over the next five years and providing EUR 420,000 per year to fund research students. Foreign investors were driven by locating near this known center of talent, which previously had not engaged with industry partners.

The UAE has also built an entire college to focus on AI called the Mohamed Bin Zayed University of Artificial Intelligence college. They are the first country to develop a college that solely focuses on Artificial Intelligence. A secure data infrastructure will be necessary to facilitate data sharing and manage privacy concerns. Investing in a single AI data infrastructure makes it easier to do this efficiently and makes it simpler to access data relevant to research or developing new products and services.<sup>381</sup>

## Regulations/ Penalties

The UAE is concerned about having a secure data infrastructure. They created a national governance review. The UAE Artificial Intelligence and Blockchain Council will add to its remit to review national approaches to issues such as data management, ethics, and cybersecurity. They will also review the latest international best practices in legislation and global risks from AI.

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<sup>380</sup> Ibid.

<sup>381</sup> Ibid.

## Section 13: Kenya AI Strategy

### **Mission Statement:**

“Key applications for the technology are framed around the Big Four Agenda, a policy orientation to focus all government energy on four key sectors—affordable healthcare, food security, manufacturing, and housing; the report adds cybersecurity and land titling to these”.<sup>382</sup>

### **Strategy:**

In 2018, the Kenyan government created a task force on AI and Blockchain to regulate AI and block chain activities. Their AI and Blockchain document identify the strategic pillars and AI regulation protocol in Kenya.

Kenya is focusing on developing AI in four areas. These areas include:

1. Affordable Housing
2. Food Security
3. Manufacturing
4. Housing

In February 2018, the Kenyan government launched a task force focusing on blockchain and AI technologies, officially known as the Distributed Ledgers Technology and Artificial Intelligence Taskforce. Kenya is looking to decentralize their system to reduce corruption.<sup>383</sup>

### **Funding and Innovation:**

Kenya is investing in startup company capabilities to help improve the lives of the Kenyan people. For example, Twiga Foods is a Kenyan start-up founded in 2014 that uses technology to streamline the delivery of agricultural produce to market. According to its website, Twiga uses AI and blockchain technology to “organize informal retail in the country” by leveraging technology to overcome inefficiencies in the country’s retail produce market. Twiga has attracted significant international attention, receiving a \$30 million loan from the International Finance Corporation to support farmers within its networks.<sup>384</sup>

### **Regulation/Penalties:**

The balance between AI and DLT (Distributed Ledger Technology) in the report suggests that the government of Kenya sees DLT as far more useful technology than AI in improving governance in Kenya. Distributed Ledger Technology (DLT) refers to the technological infrastructure and protocols that allows simultaneous access, validation, and record updating in an immutable manner across a network that's spread across multiple entities or locations.<sup>385</sup>

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<sup>382</sup> Nanjala Nyabola. “Old Cracks, New Tech: Artificial Intelligence, Human Rights and Good”. *University of Oxford*, 2021.

<sup>383</sup> Nyabola. “Old Cracks, New Tech: Artificial Intelligence, Human Rights and Good”. 2021.

<sup>384</sup> Nyabola, 2021.

<sup>385</sup> Ibid.



Data sovereignty is a major priority in Kenya. Data sovereignty is the idea that data are subject to the laws and governance structures within the nation it is collected. Kenya is looking to. It is important to note that like many developing countries, Kenya is only now starting to develop legal frameworks to govern the use of technology. Deploying AI in highly fragmented societies risks deepening existing cleavages. The Kenyan government's policy on AI and blockchain technology shows that it is eager to make these a central pillar of the country's technology policy.<sup>386</sup>

### **Foreign Policy:**

The Kenyan government's policy on AI and blockchain technology and AI shows that it is eager to make these a central pillar of the country's technology policy. But with a mixed record on government-led involvement in technology, it is important to recall that technology is political, that is, it is intimately connected to power relations between various actors. Kenya is more concerned with developing blockchain technology and AI in their country first before they develop a foreign policy strategy.<sup>387</sup>

### **Conclusion:**

It is clear that countries have many different approaches on how to innovate, regulate, and educate in the field of artificial intelligence. Many countries are playing to their economic strengths when developing their AI policies. For example, the United States is using its large economy with the supplement of government funding to innovate in hub locations. The U.S. has done this before in areas like Silicon Valley, Boston, and Austin. The U.S. tends to lean towards less regulatory frameworks compared to China and Europe, and their AI policy reflects U.S. tendencies.

Europe has recently heavily regulated technology, as demonstrated in the GDPR. Europe will plan to continue a stringent regulatory approach in their AI policy as they have with technology in the past. The People's Republic of China will continue to drive the growth of artificial intelligence with high government involvement and funding. China has innovated with the PRC dictating growth in technology in the past, and China will continue to use this method of innovation moving forward.

Countries around the world understand the importance of artificial intelligence and each nation will continue to draft legislation that addresses AI. Countries have different priorities, and the difference in the priorities creates the differences in AI policies. For example, some countries want to recruit talent in the field of AI, and others want to retain and build domestic talent. Some countries want to focus on regulating AI and ensure that their consumers are protected, and other countries are striving for more innovation with less regulation. AI policies will be a critical part of a country's national strategy and will play a major role in the global landscape moving forward.

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<sup>386</sup> Ibid.

<sup>387</sup> Ibid.

## Chapter 3 -Tradeoffs in AI Policy

“There are no solutions, there are only tradeoffs.”

- Thomas Sowell, American Economist.<sup>388</sup>

### Tradeoffs – The Implicit Optimization Problem

During the development of an AI policy framework, decision makers must evaluate the tradeoffs in AI policy and develop a framework that addresses the attributes in the tradeoff. Tradeoffs drive AI policy, and the analysis of attributes is unique to different places around the world. There is a difference between a tradeoff and an attribute. An attribute is a component or feature in the artificial intelligence space. For example, some attributes include privacy, accuracy, innovation, and consumer protection. The tradeoff is the balance between two or more attributes that often oppose each other. For example, the balance between the attributes innovation and consumer protection are a tradeoff because as you increase consumer protection, innovation decreases and vice versa. It is very difficult to maximize all attributes in a tradeoff and the reason why many government frameworks aim to balance tradeoffs under certain constraints.

It is important to note that there are often more than two attributes influencing tradeoff analysis. However, for this analysis, I will simplify the tradeoffs and narrow down the analysis to two attributes. If we look at tradeoff analysis in the lens of an implicit optimization problem, it is a vector of attributes instead of two attributes. For example, innovation, national security, consumer protection, and attracting talent all play a role in decision making. The more a policy promotes innovation and attracting talent in a country, the more national security and consumer protection will weaken. However, I will conduct a bivariate analysis to simplify the tradeoff analysis to reach the core issues in the AI policy space.

Governments, private sector leadership, computer scientists, academic researchers, and policy makers all have the ability to favor or express one attribute over another in their deployment of artificial intelligence. These individuals who are making these decisions do not view tradeoffs as percentages, rather they view them more as an implicit optimization problem. In an ideal world, every decision maker would prefer to meet the needs of both attributes in a tradeoff; however, it is simply not possible, so they must make a tradeoff analysis and make decision that may favor one attribute over the other.

As an example, the implicit tradeoff optimization problem between innovation and consumer protection is a good illustration of two attributes that oppose each other. There are two basic views of tradeoff analysis in terms of innovation vs consumer protection (These views do get more dynamic, and this is just a simplification). Examples of these two views are: View 1 - “As a country, we will maximize innovation in AI subject to the constraint of a certain baseline level of minimum regulatory measure to protect our citizens”, and View 2 - “As a country, we will maximize the protection of our citizens through regulatory measures in the field of AI subject to the constraint of a certain baseline level of innovation”. Each decision maker would prefer to

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<sup>388</sup> Larry Prather. “In flood resilience debate, there are no solutions — only tradeoffs”. *The Hill*, 2019.

maximize both; however, it is not possible. In any organization, there is a certain baseline level of the minimum that must be met, otherwise known as non-negotiables or red lines. The image below depicts how a decision maker would implicitly view the optimization problem between innovation and consumer protection as an example. Note that policy makers do not actually graph these two tradeoffs and conduct the optimization problem, rather it is a simplified implicit analysis.

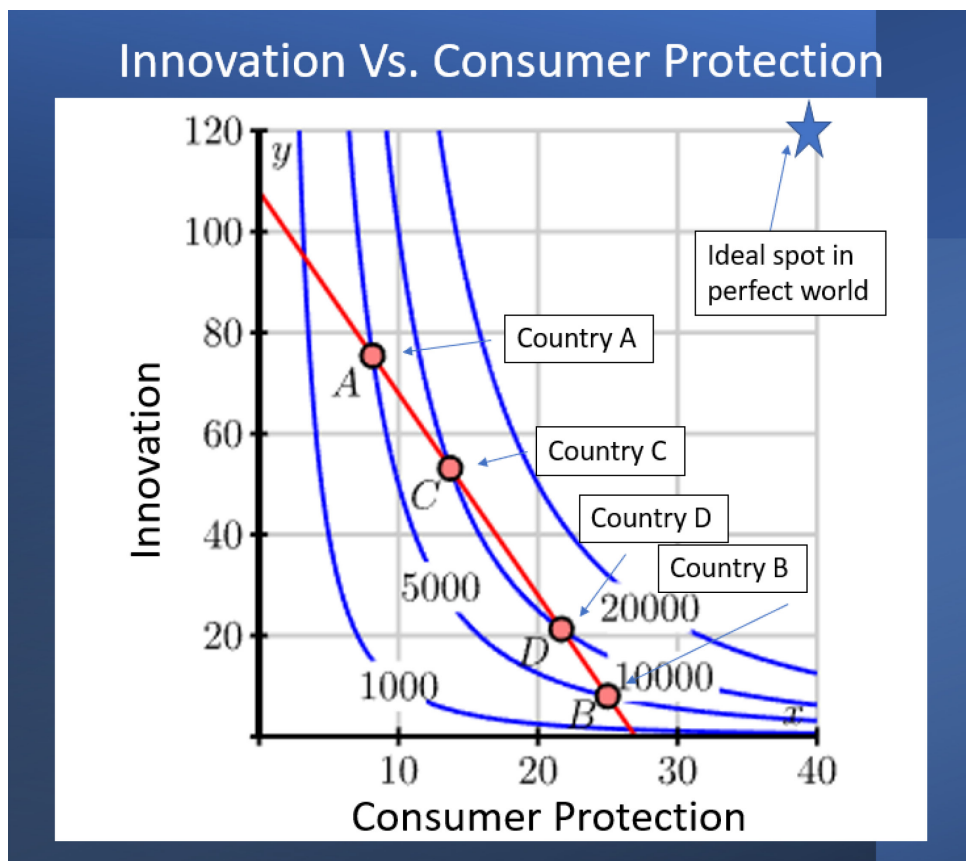


Figure 11. Innovation vs Regulation optimization problem.

The image above illustrates how decision makers might view the innovation vs consumer protection tradeoff analysis. The star in the upper right is the ideal place to be in any organization; however, you cannot maximize both innovation and consumer protection as they counter each other. Rather, they must look at it in the lens of this graph. Country A is a country that aligns more with view 1 and country B is a country that aligns more with view 2. As you can see, no country wants to completely max one attribute and ignore the other. This graph can apply to all of the tradeoffs mentioned below. The last section of this chapter states the implicit optimization problem for each tradeoff scenario and gives two simplified views that organizations can take when drafting their AI policies. It is important to note that existing models have the tradeoffs outlined below. In the future, there may be improved technologies or better models that can address these tradeoffs.

## Technical Tradeoffs in AI Policy

### Explainability vs Accuracy

With the advances of machine learning, AI systems have significantly improved their ability to perceive, learn, decide, and act on their own.<sup>389</sup> Some of these advanced AI systems are making decisions that are sometimes not comprehensible by humans. However, AI systems are making decisions and inferences that humans cannot make, which in turn save lives, improving the wellbeing of humans, and helping people think in new ways. To counter, individuals like Sendhil Mullainathan points to the fact that explainability is critical and allows for decision makers (like doctors, financial advisors... etc.) to interpret and explain the reasoning of the system's decision to their patients and customers.<sup>390</sup> This is the tradeoff; the most accurate models can often be the least explainable. Decision makers are forced to either simply accept the decision of the AI system (which could be better than their own) or forced to use a less complex model (which could be less accurate) in order to allow for explainability.

The more complex the system, the harder it is for humans to interpret how the system produced its decision. The simpler models like decision trees are often more explainable than the more complex models like deep learning models.<sup>391</sup> The graph below shows the tradeoff between performance (or accuracy) vs explainability in terms of different learning models.

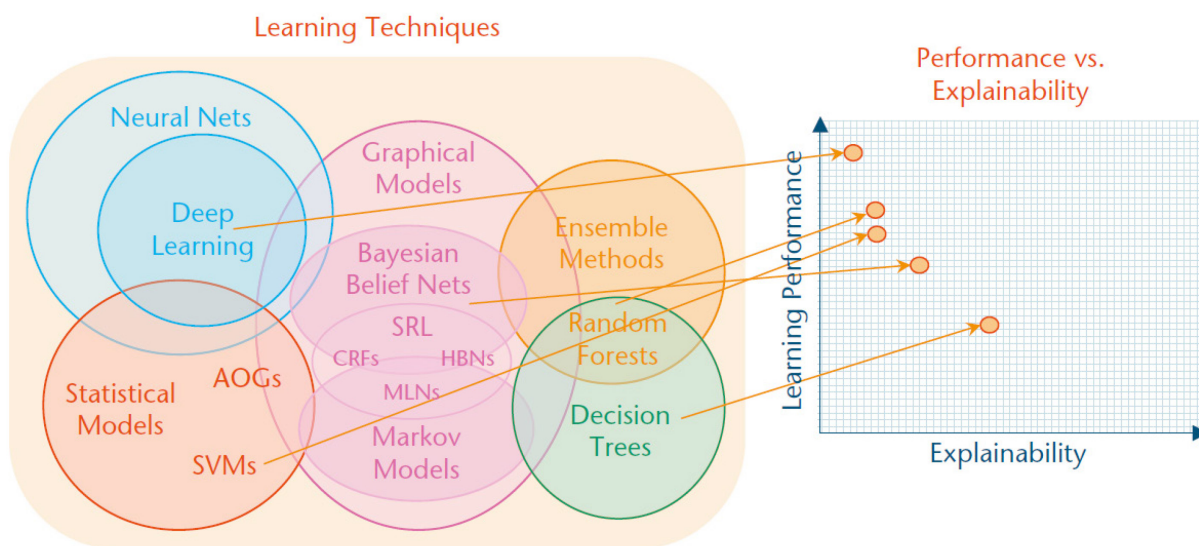


Figure 12. Performance (Or Accuracy) vs Explainability.<sup>392</sup>

<sup>389</sup> David Gunning and David Aha. "DARPA's Explainable Artificial Intelligence Program". *Association for the Advancement of Artificial Intelligence*, 2019.

<sup>390</sup> Sendhil Mullainathan et al. "An Economic Perspective on Algorithmic Fairness." *AEA Papers and Proceedings*, 110: 91- 95. 2020.

<sup>391</sup> David Gunning and David Aha. "DARPA's Explainable Artificial Intelligence Program". *Association for the Advancement of Artificial Intelligence*, 2019.

<sup>392</sup> Gunning and Aha. "DARPA's Explainable Artificial Intelligence Program". 2020.

As you can see from figure 2 above, the more complex learning techniques like deep learning and SVMs have higher performance and accuracy; however, have lower explainability. Decision trees on the other hand are much more explainable for decision makers; however, they are less accurate. This tradeoff comes down to what the decision maker values more.

Deep learning practices have a difficult time providing reasons for their conclusions. For example, when you train a neural network to identify a cat, it will use parts of the picture that cannot be explained by humans to identify a picture of a cat. A neural network will be accurate when identifying cats; however, it uses different pixels and colors to identify the cat – a method that humans do not use when identifying a cat. Humans have a hard time comprehending how exactly the system determines a cat.

This is a classic example used when depicting the tradeoff between explainability and accuracy. Do individuals really care why the system says it's a cat? If it is more accurate at identifying cats in a picture than humans, people might not care how the deep learning system came to that conclusion. However, what if someone demands an explanation on the reasoning for the identification of a cat? What happens when the system wrongfully identifies a cat? Who is held responsible?

If a decision maker is in a field that needs to explain the decision of an AI system like finance, then a decision tree might be a better option. For example, it is unethical for a financial advisor to use an AI system that uses deep learning and rejects a loan for an individual without a clear reason. If the financial advisor cannot explain its decision, then there is a clear ethical issue.

There are existing laws that prevent companies and people from rejecting applications on the basis of their age, race, gender, etc. One example is the Equal Credit Opportunity Act (ECOA), passed in 1974. This act prohibits discrimination on the basis of race, color, religion, national origin, sex, marital status, age, receipt of public assistance, or good faith in the credit decision making process.<sup>393</sup> Individuals in the finance world are trained and required to meet the content outlined in ECOA; however, AI systems are not human and can make mistakes that violate ECOA.

Additionally, the Fair Credit Act protects information collected by consumer reporting agencies such as credit bureaus, and tenant screening services.<sup>394</sup> AI systems, just like humans need to be trained to have outputs that comply with pieces of consumer protection legislation like ECOA and the Fair Credit Act. It is illegal to use race or gender as a reason to accept or deny loan applications, and we need to make sure that our AI systems comply with our laws.

Fields like finance that need explaining in the decision-making process will be very hesitant to use these complex systems. Politicians would never get elected if they used a system to make decisions for them. That is a major part of their job, to explain the reasoning behind decisions and policies to the people they represent.

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<sup>393</sup> "Equal Credit Opportunity Act". *The Federal Trade Commission*, 1974.

<sup>394</sup> "Fair Credit Reporting Act". *The Federal Trade Commission*, 2018.

## Fairness vs Accuracy

As our society continues to innovate AI systems and make them more accurate, ethical issues arise regarding the fairness and bias in these systems. The definition of fairness in the field of AI is a very ambiguous term. Some define fairness in terms of statistical parity; therefore, one could argue that it is the difference in probabilities of a positive outcome across two groups.<sup>395</sup> However, some claim that fairness should be defined at the individual level quantitatively, while others point to more qualitative measures at the group level.<sup>396</sup>

There are several quantitative tools that measure fairness in AI such as IBM's Fairness 360 Toolkit which focuses on technical solutions through fairness metrics and algorithms to help users examine, report, and mitigate discrimination and bias in ML models.<sup>397</sup> To contrast IBM's Toolkit, the Microsoft researchers developed a qualitative measure of fairness called the co-designed AI fairness checklist which includes items to cover at the different stages of an AI system development and deployment lifecycle (i.e., envision, define, prototype, build, launch, and evolve).<sup>398</sup>

There are other works that group fairness into two main families: static notions of fairness and individual notions of fairness.<sup>399</sup> The statistical notion of fairness is more widely accepted and asks for an approximate the parity of some statistical measure across different groups. Some of these measures include raw positive classification rate, false positive rates, and false negative rates.<sup>400</sup> To contrast, individual notions of fairness ask for constraints that bind on specific pairs of individuals, rather than across groups.<sup>401</sup> For example, a constraint could be that "similar individuals should be treated similarly" where similarity is defined with respect to a specific metric that must be determined case by case (Chouldechova and Roth, 2018). This is another way researchers and policy makers are viewing fairness as well.

Accuracy is a bit simpler to define, and we can assume that accuracy is the ability to measure the correct outcomes. You cannot maximize both fairness and accuracy, similar to how you cannot maximize innovation and consumer protection. Michael Kearns and Aaron Roth outline the tradeoff between fairness and accuracy in their work, "The Ethical Algorithm". Kearns and Roth use an example of SAT scores as an example to illustrate the tensions that occur between fairness and accuracy. These two authors in their work take two hypothetical populations, squares and circles and differentiate the two in terms of college admissions and SAT scores. Circles on average have higher SAT scores with more access to resources and are able to take the SAT more times due to their financial situation. Squares often have less resources and financial tools; therefore, their SAT scores are lower than the circle's scores.<sup>402</sup>

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<sup>395</sup> "About Algorithmic Fairness". *Jurify*, 2021.

<sup>396</sup> Genevieve Smith. "What does "fairness" mean for machine learning systems?". *UC Berkley*, 2020.

<sup>397</sup> Smith. "What does "fairness" mean for machine learning systems?". 2020.

<sup>398</sup> Smith, 2020.

<sup>399</sup> Alexandra Chouldechova and Aaron Roth. "The Frontiers of Fairness in Machine Learning". *Cornell University*, 2020.

<sup>400</sup> Chouldechova and Aaron Roth. "The Frontiers of Fairness in Machine Learning". 2020

<sup>401</sup> Chouldechova and Roth, 2018.

<sup>402</sup> Michael Kearns and Aaron Roth. "The Ethical Algorithm". *Oxford University Press*, 2019.



The image below represents applicants to a hypothetical university (Fairness State), and the outcomes of past students.

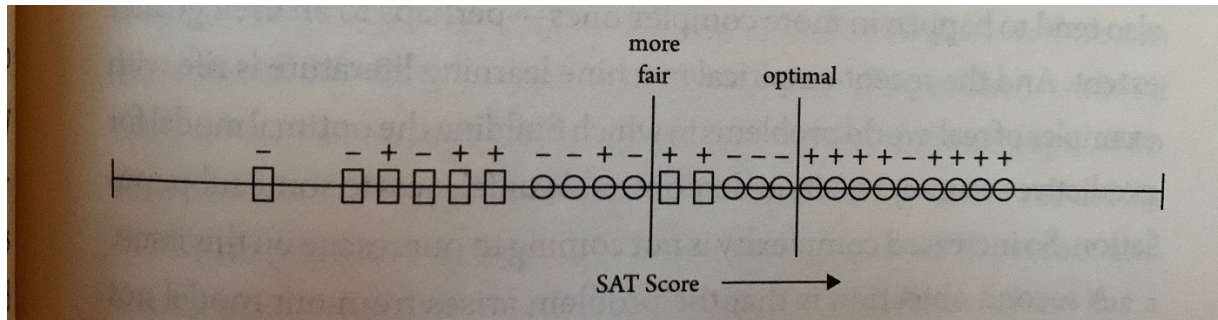


Figure 13. Hypothetical College Admission Comparison from Kearns and Roth, "The Ethical Algorithm"<sup>403</sup>

The image above depicts results from past circle and square students. Students with the + sign successfully finished college and the students with the – sign did not successfully finish college. It is important to note that in Kearns and Roth’s analysis, SAT scores were not a determinant of college success; rather, the circles had inflated SAT scores from their resources.

Using figure 2 above, we can see that the optimal line for admissions would be the most accurate. It is the most accurate because there would only be one false prediction out of nine accepted. However, this is not as fair to the square students because none of the square students had high enough SAT scores due to their lack of resources. Therefore, the fairer line includes two squares who had high enough SAT scores to diversify the accepted students. However, the model is not as accurate because now you are including three circles who are not going to succeed.<sup>404</sup>

With more complex methods, we can build two separate algorithms specific to the population to try and increase fairness and accuracy at the same time. The image below shows a college admissions decision when building separate models for the two populations.

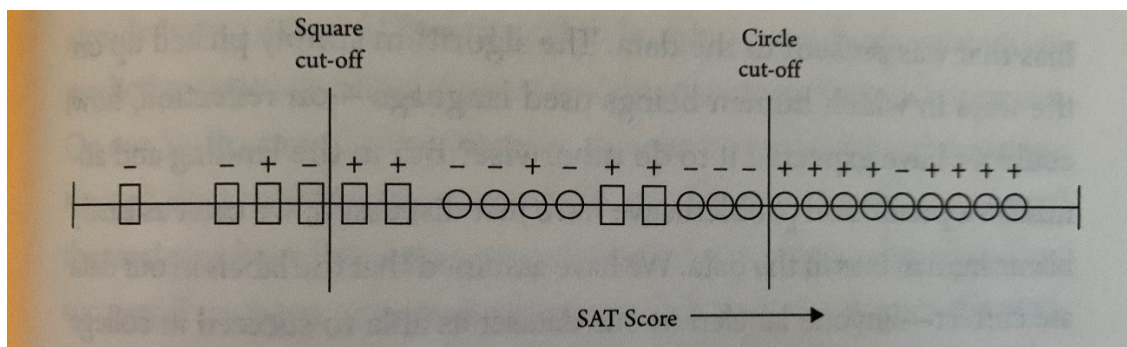


Figure 14. Hybrid Model proposed by Kearns and Roth.<sup>405</sup>

<sup>403</sup> Kearns and Roth. "The Ethical Algorithm". 2019.

<sup>404</sup> Kearns and Roth, 2019.

<sup>405</sup> Ibid.



This model seems to address both fairness and accuracy better. The circles still have the same accuracy, and the squares now have more inclusion into the college. The false acceptance rate for circles remains the same with an error rate of 11% and squares with no error rate. This is the method that many affirmative action programs use in college admissions; however, there are major issues with this model because now we are explicitly using race as an input to determine the outcome of a decision. There are many laws that forbid race as being a significant determinant as a decision maker because it can be used to increase discrimination rather than decrease it.<sup>406</sup>

Ashesh Rambachan and Sendhil Mullainathan give another perspective on the accuracy vs fairness tradeoff through the concept of “Algorithmic Fairness”. They highlight that there are widespread concerns that machine learning algorithms are reinforcing and reproducing racial discrimination against minority groups.<sup>407</sup> In their work, they give an example of an AI system using a judge’s sentencing history of two groups of men who committed the same crime – one group white and one group African American.

They state that if judges in the past have sentenced the African American group for a longer sentence than the white group, then the AI system will train itself to continue to sentence African Americans for a longer sentence for the same crime. The system would inherently use the judge’s higher threshold for African American’s sentencings compared to the other white group. There is no statistical test that can be used to determine the fairness of the system due to the higher threshold of past data. The only way to correct this issue is through reforms in the judge’s behaviors and sentencing practices.<sup>408</sup>

This example highlights how the use of previous data can be detrimental to the fairness of an algorithm. A system might view a decision as being “fair” based on previous data; however, as humans we know that this decision is far from fair. There are ideas of how to mitigate this issue through algorithmic regulation; however, the adjustments that need to be made in the algorithm can make the decisions much less accurate for all groups. This is the problem that many decision makers and computer scientists must face; how to reduce the bias in the AI system while still having the system produce accurate results. Mullainathan and Rambachan have similar claims as Kearns and Roth which states that increases fairness do come at a cost of reduced accuracy and vice versa.

To contrast Rambachan and Mullainathan, some believe that fairness and accuracy are not always in tension with each other under certain conditions. Michael Wick and his team found that the relationship between fairness and accuracy while controlling for label and selection bias are not a trade-off and is actually mutually beneficial.<sup>409</sup> They also point to the fact that assessing fairness is an important factor in determining the relationship between the two. Fairness has

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<sup>406</sup> Ibid.

<sup>407</sup> Ashesh Rambachan, Jon Kleinberg, Jens Ludwig, and Sendhil Mullainathan. “An Economic Perspective on Algorithmic Fairness.” *AEA Papers and Proceedings*, 2020.

<sup>408</sup> Rambachan et al. “An Economic Perspective on Algorithmic Fairness”. 2020.

<sup>409</sup> Michael Wick and Tristan Jean-Baptiste. “Unlocking Fairness: a Trade-off Revisited”. *Conference on Neural Information Processing Systems*, 2019.

many definitions and can be ambiguous. Wick's work is in the early stages and does not have a lot of research that needs to be followed.

Overall, there seems to be a tension between fairness and accuracy. It is clear that most believe that increased accuracy comes at the cost of reduced fairness. The key for decision makers and AI developers is to determine their goals when implementing the algorithm. If they decide that fairness is more important, then they should develop an algorithm that favors fairness and vice versa.

### Privacy vs Accuracy

In addition to fairness vs accuracy, privacy vs accuracy is another tradeoff that decision makers must analyze when deploying AI systems. Accuracy when compared to privacy is a much different tradeoff than fairness. The privacy and accuracy tradeoff occurs because in order for AI systems to be more accurate and make better real-world predictions, the systems need more data. Accuracy in models increases when there is more aggregate data (sample size), and more attributes. However, when the data collected is on human beings, privacy becomes a major concern, even when the data is anonymous.

There are many definitions of privacy when applied to machine learning. One basic default definition of privacy is having the power to seclude oneself, or information about oneself, in order to limit the influence others can have on our behavior.<sup>410</sup> However, when privacy is viewed in the lens of machine learning, there are many different ways to interpret privacy. Some definitions address the anonymity of users, the diversity of the users, and the closeness of the data points.<sup>411</sup> Differential privacy is a standard practice used as a framework to quantify the degree to which the data privacy of each individual in the dataset is preserved while releasing the output of the algorithm.<sup>412</sup> Adding the proper amount noise helps obtain differential privacy; however, there will be a loss in the accuracy of the output.<sup>413</sup> There are many examples that show why the tradeoff between privacy and accuracy matters, and why decision makers need to understand this tradeoff in their decision-making process.

In the 1990s, a government agency in Massachusetts called Group Insurance Commission (GIC), decided to help academic researchers by releasing data from hospital visits from every state employee anonymously to data scientists.<sup>414</sup> The reason for this was to improve the accuracy of models. There are many potential benefits to releasing data like this to improve models and save lives. AI systems may be able to help improve the medical field or cure diseases with an increase in medical data. AI has the potential to improve the lives of millions of people in the medical

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<sup>410</sup> Michael Dean. "AI and the Future of Privacy". *Towards Data Science*, 2018.

<sup>411</sup> Ji Zhanglong, Zachary Lipton, and Charles Elkan. "Differential Privacy and Machine Learning: a Survey and Review". *Cornell University*, 2014.

<sup>412</sup> Mohit Kumar, Michael Rossbory, Bernhard Moser, Bernhard Fredenthaler. "Deriving an Optimal Noise Adding Mechanism for Privacy-Preserving Machine Learning". *Communications in Computer and Information Science*, 2019.

<sup>413</sup> Kumar et al. "Deriving an Optimal Noise Adding Mechanism for Privacy-Preserving Machine Learning". 2019.

<sup>414</sup> Kearns and Roth, 2019.

field when the systems see more data because the systems are able to make better inferences and save more lives.

However, in this example in the 1990s, an MIT PhD student was skeptical about the “anonymous” data and wanted to see if she could pinpoint the Massachusetts governor’s medical records, even though the patient’s data was anonymous.<sup>415</sup> She did her research, found out the governor’s birthday, and zip code. She ended up pinpointing the governor’s medical data by matching up his sex, zip code, and birthday. She now could identify all of his personal medical data. She sent this medical data to his office.<sup>416</sup>

The purpose of this story is to highlight that even though many companies state they release their data anonymously, this anonymous data can be exploited and with enough background information, your personal data can be matched to you. Once someone or a company has matched your data, it can be dangerous and invasive. For example, in 2018, the New York Times was able to collect location information on many individuals and exploit it. They were able to identify a forty-six-year-old math teacher named Lisa Margin and could track her location.<sup>417</sup>

The New York Times knew where she lived, knew that she visited weightwatchers, a dermatologist, and her ex-boyfriend.<sup>418</sup> This is clearly an invasion of privacy and it occurred because companies wanted to have location information to improve her ad experience for example. Clearly this is not ethical, and privacy clearly needs to be maintained.

However, a lot more innovation and better products can be developed when companies have more data and information. With more amounts of data, more lives can be saved in the medical field, fraud detection can be more accurate in the financial sector, and car manufacturers can create lifesaving functions. Systems can make better predictions (like fraud detection or cancer detection) with more data, and it can help improve the quality of our society. Data creates a competitive advantage for firms and countries because it allows them to make better products for people.<sup>419</sup> More data can help companies make their products more secure and reliable. There are significant advantages for firms who have more data, because they are able to deliver a better product to the world.<sup>420</sup>

There are laws like the Health Insurance Portability and Accountability Act (HIPPA) that prevent the dissemination of medical information. This is important, because in order for AI systems to make accurate decisions in the medical field, they need more data. With more data, there are more opportunities for decision makers to violate HIPPA laws in the process of gathering data. This law was created to protect individual’s medical information. AI systems must meet these requirements. If AI systems had more data to leverage, they could be more accurate at detecting diseases or cancer. However, in the process of this, there are more

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<sup>415</sup> Ibid

<sup>416</sup> Ibid.

<sup>417</sup> Ibid.

<sup>418</sup> Ibid.

<sup>419</sup> Keith Negley. “When Data Creates Competitive Advantage”. *Harvard Business Review*, 2020.

<sup>420</sup> Negley. “When Data Creates Competitive Advantage”. 2020

opportunities for policy makers to violate HIPPA laws when gathering more information to make the AI systems more accurate.

This is why the tradeoff between privacy and accuracy is difficult. With more data, AI systems can make better predictions that can identify cancer better, save lives in cars, and identify fraud. Companies can significantly improve the lives of our citizens with more data. However, the improved accuracy of our systems comes at a cost. More data is required to make the systems more accurate. Sometimes, this data can be manipulated or exploited like we saw in the examples above with the Massachusetts governor and Lisa Margin. This is why the tradeoff between privacy and accuracy is difficult.

To combat the privacy invasions and concerns that we see from these systems, like the case of Lisa Margin, AI developers have introduced the concept of differential privacy to give users more privacy. Differential privacy is a common approach to increase the anonymity of individuals in a dataset. The most classical approach for attaining differential privacy is to alter the function's output by adding random noise adjusted to the global sensitivity function (Kumar et al, 2019). The random noise protects the information of specific users in the dataset. Differential privacy protects users' information and has been a touted tool for protecting the information of citizens throughout the process of generating a model.

In the process of differential privacy, identifiable attributes such as names, addresses, zip codes, date of birth, are removed from the dataset.<sup>421</sup> The introduction of differential privacy in models has had great impacts on protecting the privacy of individuals. Additionally, developers can add more random noise to protect the anonymity of the individuals in the dataset. This random noise are data points that are not real data points and simply put, is a mask of fake data that protects the privacy of users in the dataset. Differential privacy is a great tool to protect the privacy of citizens.

This tradeoff is also known as the privacy-utility tradeoff in machine learning. Noise is injected into the machine learning pipeline at different stages of the algorithm in attempt to guarantee data privacy for the users.<sup>422</sup> In general, there are three positions of the machine learning pipeline where differential privacy noise can be applied to a machine learning task. These three stages include data collection, machine learning training, and model finalization.<sup>423</sup> See figure 3 below for a visual of when differential privacy noise can be introduced in the development of the machine learning algorithm.

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<sup>421</sup> "Differential Privacy" *Harvard SEAS*, 2022

<sup>422</sup> Benjamin Zhao, Mohamed Kaafar, and Nicolas Kourtellis. "Not one but many Tradeoffs: Privacy Vs. Utility in Differentially Private Machine Learning". *CCSW*, 2020.

<sup>423</sup> Zhao et al. "Not one but many Tradeoffs: Privacy Vs. Utility in Differentially Private Machine Learning". 2020.

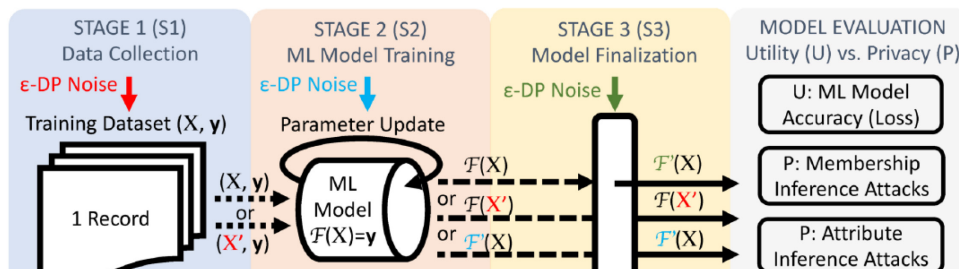


Figure 15. Different Stages Where Differential Privacy Noise Can Be Added to the Machine Learning Pipeline.<sup>424</sup>

However, when developers add too much random noise, the accuracy of the output is reduced. This decrease in accuracy can have devastating results. For example, too much random noise can result in the loss of lives, the losses of millions of dollars, or incorrectly rejecting applications. An increase in differential privacy can also negatively impact anomaly detection.<sup>425</sup> Anomaly detection is the identification of events or observations that do not match the expected pattern or other items of the dataset.<sup>426</sup> It is extremely useful for identifying anomalous events like credit card fraud and cyber-attacks.

In Zhao's work, they show that as you increase the noise that is introduced (Epsilon) the accuracy decreases significantly. See the figure below for an in-depth analysis of how accuracy decreases when noise (epsilon) increases for different machine learning algorithms.

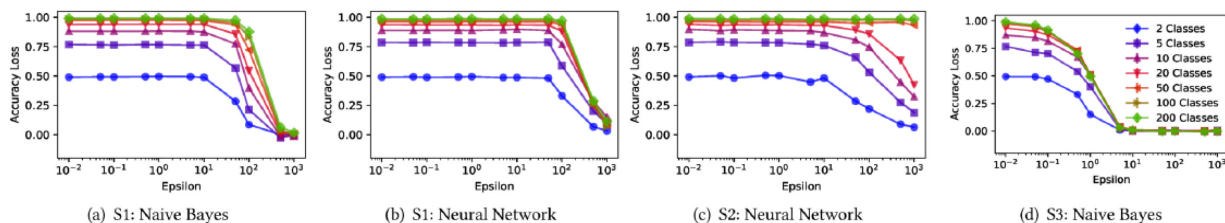


Figure 16. Different amounts of Noise (Epsilon) added to Machine Learning Algorithms<sup>427</sup>

The biggest takeaway from the figure above is that it does not necessarily matter what machine learning technique is used, an increase in noise (epsilon) will significantly decrease accuracy. This is the privacy-utility tradeoff in differential privacy. Figure 16 shows that there is an issue when too much random noise is used as a tool to anonymize users in the data set.

When too much noise is introduced to achieve differential privacy, the accuracy of detecting anomalous activity significantly decreases.<sup>428</sup> The random noise makes the data more normal, and it is much more difficult to identify anomalous data points in the dataset. This can have severe implications. For example, it may be harder for credit card companies to identify fraud or

<sup>424</sup> Zhao et al, 2020.

<sup>425</sup> Mengwei Yang, Song Linqi; Jie Xu; Congdun Li, and Guozhen Tan. "The Tradeoff Between Privacy and Accuracy in Anomaly Detection Using Federated XGBoost" *Cornell University*, 2019.

<sup>426</sup> Yang et al. "The Tradeoff Between Privacy and Accuracy in Anomaly Detection Using Federated XGBoost". 2019.

<sup>427</sup> Zhao et al, 2020.

<sup>428</sup> Yang et al, 2020.

for doctors to identify cancer cells. If privacy is the main concern, then the accuracy of these important predictions like credit card fraud will decrease.

The confusion matrix below shows how this tradeoff occurs. With the addition of random noise in a dataset, the prediction of system is more likely to be false.

		Prediction outcome		total
		p	n	
Actual value	p'	True Positive	False Negative	P'
	n'	False Positive	True Negative	N'
total		P	N	

Figure 17. Table that outlines the confusion matrix of an anomaly detection model.<sup>429</sup>

The false negatives quadrant is where the most concern occurs when applying random noise to achieve differential privacy. If the system does not identify anomalous behavior when there is in fact anomalous behavior, a false negative will occur. There is a major ethical violation if the system produces a false negative as a result of too much random noise to protect users. This means that credit card thieves can get away with theft, and that doctors may not be able to identify a cancer cell. These implications are severe and the balance between privacy and accuracy is an essential tradeoff that decision makers need to evaluate.

#### Lesson Learned – Accuracy Comes at A Price

These three attributes discussed above (explainability, fairness, and privacy) all have a tradeoff with accuracy. It is clear that when decision makers prioritize accuracy, many other issues with the model arise. Computer scientists and developers of algorithms cannot evaluate the effectiveness of their model solely on accuracy. Although high accuracy is important to have in a model, it cannot be the sole determinant to evaluate the effectiveness of a model because as you can see, when accuracy increases, explainability, fairness, and privacy all decrease to some degree.

The key is for a model to balance these four attributes as much as possible, and to address situation-specific models. This is no easy task; however, accuracy is the determinant of the other three attributes in AI policy. It is also important to realize that the goal of the model is essential to understand when evaluating these tradeoffs. For example, if the goal of the model is to identify the correct enemy target when conducting an airstrike, the accuracy of the model is at the upmost importance. The privacy of people's data when developing a model for an airstrike on an enemy should be held at a minimum threshold, and the accuracy of the model should be

<sup>429</sup> Ibid.

maximized. However, when it comes to college admissions, fairness should be a higher concern and the accuracy of the model may need to decrease.

There is no clear-cut answer with a lot of these situations; however, there are clearly times when accuracy needs to be prioritized and times when the other three attributes need to be addressed and prioritized more in models. Computer scientists and developers need to understand these tradeoffs and the goal of the model when creating algorithms.

### Privacy vs Fairness

In the field of artificial intelligence, the tradeoff between privacy and fairness is starting to emerge as a major issue that decision makers need to address. Research shows that simultaneously attempting to achieve privacy and fairness leads to inaccurate algorithms.<sup>430</sup> An increase in privacy will directly lead to a more unfair output in machine learning algorithms and vice versa. Increased privacy occurs at the cost of fairness.

Sanyal and team found that privacy constraints hurt fairness for accurate models.<sup>431</sup> The image below illustrates the effects of increased privacy on fairness. The concept of group fairness applies to this work. When there are more privacy constraints with the addition of random noise in the algorithm, then the model is more unfair to minority groups.

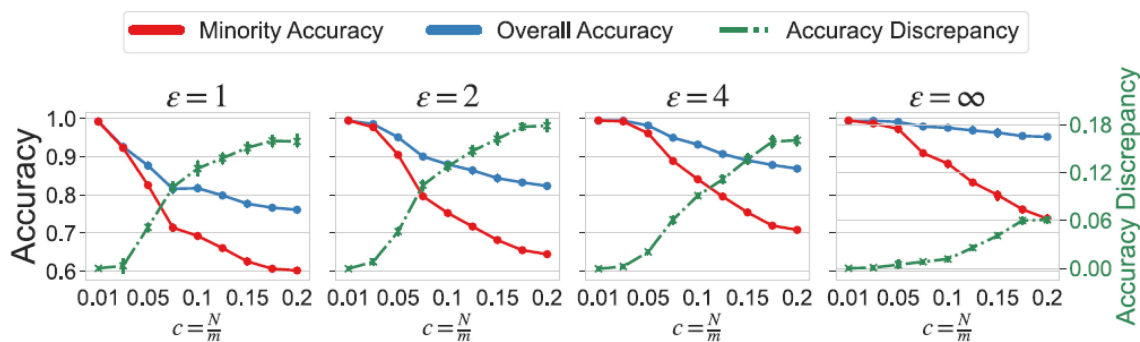


Figure 18. Privacy and Fairness Tradeoff Illustrated.<sup>432</sup>

The  $\epsilon$  parameter is the privacy parameter of approximate differential privacy, and the  $c$  variable is the ratio of the number of minority subpopulations to the size of the dataset. The far-left graph where  $\epsilon = 1$  achieves the strictest level of privacy in the algorithm, and the far-right graph where  $\epsilon = \infty$  has no privacy constraints.<sup>433</sup> This graph has a lot of moving parts; however, the conclusion to this analysis is simple; when you increase the privacy constraints ( $\epsilon=1$ ), minority accuracy significantly decreases. This means that when developers prioritize privacy, the more unfair the model is. If developers want to increase the fairness of a model for minority groups, then the privacy restrictions must decrease.

<sup>430</sup> Amartya Sanyal. "How unfair is private learning?". *Conference on Uncertainty in Artificial Intelligence*, 2022

<sup>431</sup> Sanyal. "How unfair is private learning?". 2022.

<sup>432</sup> Sanyal, 2022.

<sup>433</sup> Ibid.

Furthermore, Bagdasaryan and his team find that adding random noise into machine learning algorithms to increase privacy, it disproportionately affects underrepresented groups and subgroups.<sup>434</sup> This team used a Flickr-based Diversity in Faces (DiF) dataset and the UTKFace dataset to analyze the effects of increasing privacy on minority groups with darker skin.<sup>435</sup> They find that as privacy restrictions increase in their dataset, the accuracy of classifying an individual with darker skin decreases more comparatively to lighter skin individuals, which clearly increases unfairness. The image below shows the results of their experiment.

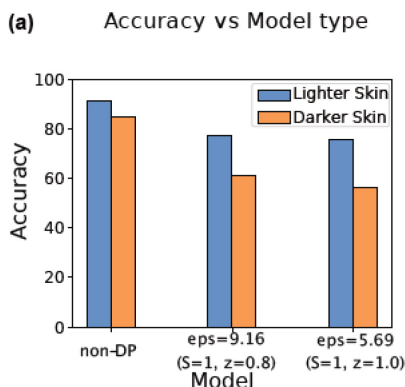


Figure 19. Illustrating Fairness and Privacy in Facial Recognition Classification.<sup>436</sup>

Their research shows that as you introduce more privacy restrictions ( $z$ ), the accuracy of the model significantly decreases more for the darker skin group as opposed to the lighter skin group. Similar to Sanyal's experiment, Bagdasaryan found that as privacy restrictions increase, minority groups are put at a disadvantage.

The tradeoff between privacy and fairness is important, it is a very tough decision to make. In today's world with an increased pressure of governments to impose privacy restrictions on companies, it inherently makes the models more unfair. The GDPR and California's data protection law are some examples of governments imposing privacy restrictions on companies that could affect the fairness of the models. Moving forward, it will be important for decision-makers to analyze how fairness and privacy affect each other, because it will be an essential tradeoff moving forward.

## Broader Tradeoffs in AI Policy

### Innovation vs Consumer Protection

The tradeoff between innovation and consumer protection is one of the most important tradeoffs policy makers discuss when implementing their respective AI policy. Consumer protection regulatory frameworks protect privacy, individual rights, and reduce bias. Broadly speaking, the more an organization or country prioritizes consumer protection with regulatory frameworks to protect people's rights, the more likely innovation will plateau. On the contrary, the more an

<sup>434</sup>Eugene Bagdasaryan; Omid Poursaeed, and Vitaly Shmatikov. "Differential Privacy Has Disparate Impact on Model Accuracy". *Conference on Neural Information Processing Systems*, 2019.

<sup>435</sup> Bagdasaryan et al. "Differential Privacy Has Disparate Impact on Model Accuracy". 2019.

<sup>436</sup> Bagdasaryan, 2019.



organization allows for innovation and breakthroughs in AI, the more likely privacy and individual rights violations will occur.

Regulations are needed to increase consumer protection from unethical and dangerous AI systems. The key is to find which regulations are effective and necessary in the AI policy space. More regulations impose restrictions on companies, AI developers, and industries. These restrictions will impede innovation in AI. This is the tradeoff. More regulations allow for more consumer protection; however, these regulations will stifle innovation in the field of artificial intelligence.

For artificial intelligence to grow, systems need more data and more opportunities to try new methods. Innovation occurs when developers of AI systems can use new methods and have access to more data. We are seeing a lot of innovation in deep learning practices such as neural networks. Neural networks require a lot of data to perform well, because the larger the pool of data, the better the system represents the real world.

Deep learning doesn't rely on human expertise as much as traditional machine learning. Deep learning makes discoveries in data when developers are not sure what they are trying to find. For this innovation to occur in deep learning practices, if the government heavily regulates the data, then it is much more difficult to allow deep learning to drive the innovation. Either these systems must be placed in sandbox experimentation to grow or put into society to grow.

In the process of innovation and growth, AI systems are not that much different than humans. For a human to grow and innovate, individuals must try new things and fail before they see success. Artificial intelligence works in similar ways. The systems need to fail and try new avenues of approach before it can become successful in predicting outcomes. However, when countries solely prioritize innovation, privacy and ethical concerns arise. There are consequences in allowing AI systems to fail and try new avenues of approaches, because these systems can have severe consequences for humans when they are wrong.

Deep learning requires a lot of data, and data privacy is a large concern in areas such as finance, healthcare, and education. However, there are some areas of deep learning that do not have privacy issues regarding data. Deep learning and other machine learning practices are being used to find oil for example. In this specific example of oil, violating individual rights in terms of AI systems that find oil is not an issue; therefore, innovation can occur without the fear of invading the rights of people. With that being said, there are many ethical issues with deep learning that regulations can address.

However, a focus on more innovation in the medical field for example can violate the rights of consumers and patients. For an AI system to be more innovative and to make better decisions, it needs to have more data. In the medical field, more data on individuals can invade their privacy and cause ethical concerns. There clearly needs to be some type of regulation that protects the medical information of individuals. AI systems may have more capabilities with more access to data; however, this increased access may violate the medical privacy of individuals.

This not only applies to the medical field, but in many other fields such as finance, education, and law. The more information and data you give these AI systems, the more likely individual

rights are to be violated. For example, to enhance consumer protection, the European Union has developed one of the most comprehensive frameworks to protect the rights of their citizens through extensive regulations on data and privacy. Although this may inhibit innovation in the field of AI, some argue that European citizens have a higher baseline level of protection.

### Attracting Talent Vs National Security

Every country would like to maximize both talent attraction and national security; however, governments cannot maximize both. We see countries opt to attract more international talent through more lenient citizenship and visa policies to attract foreign talent. Canada, the UK, and the UAE are creating policies that drive more talent to their countries. If a country is able to attract more talent in the STEM field, then the host country directly receives the benefits of innovation and research that takes place. Additionally, if countries have open immigration policies, then it is easier to attract more foreign talent in the technology sector. Foreign citizens are able to bring different perspectives and more talent to any given society.

However, there are clear drawbacks of attracting foreign talent in the STEM field. When more foreign citizens have access to technology in a given country, there is a higher risk of national security breaches. Additionally, if foreign citizens are developing more technologies for the host country to use, it is easier for a foreign country to manipulate and take advantage of domestic citizens. This is why several countries opt to have stricter visa policies and develop talent inside their own country.

The benefit to having stricter policies to protect national security is that the host country's national security is more secure. There are far less opportunities for adversaries to take advantage of domestic AI technologies that threaten national security. However, the drawback to closed immigration policies is that innovation may stall, and it is harder to attract talent in the field of AI. Countries with more national security threats like the United States and China may opt to have policies that favor national security and make it more difficult for foreign citizens to have access to domestic technologies and companies.

### Innovation vs National Security

Emerging disruptive technologies (EDTs) such as deep learning, quantum computing, and nanotechnology have incredible opportunities that could solve many of today's security problems and provide the U.S. with an edge over their adversaries.<sup>437</sup> These new technologies could provide solutions to cybersecurity problems which could more effectively counter threats from China and Russia. However, some of these technologies have the possibility of being ineffective and a waste of money. More consequentially, these technologies could have significant unexpected consequences and vulnerabilities that can degrade national security.<sup>438</sup>

EDTs could revolutionize fields of warfare and give the United States an even greater upper hand in warfare on a global level. However, there are significant risks with developing these

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<sup>437</sup> Christian Fjader. "Emerging and Disruptive Technologies and Security: Considering Trade-Offs Between New Opportunities and Emerging Risks". *Disruption, Ideation and Innovation for Defense and Security*, 2022.

<sup>438</sup> Fjader. "Emerging and Disruptive Technologies and Security: Considering Trade-Offs Between New Opportunities and Emerging Risks" 2022.

systems. Some questions to consider include, who will be developing these systems? Will it be the public sector? Private sector? Academia? The potential for national security risks when implementing new EDTs are significant. For example, if the U.S. government does not feel that the DOD can develop these technologies and rely on private sector models, there could be significant national security threats. What if private companies have foreign citizens developing the technologies? If the company is using Russian or Chinese coders to develop the EDTs for the U.S. government to use, there is a major concern.

As a result of this tradeoff between innovation and national security, the National Defense Strategy recognized the importance of EDTs and attempted to provide clarity on how to innovate EDTs and protect national security. This commission proposed that the U.S. government doubles its investment in AI to \$32 Billion by 2026.<sup>439</sup> The EU has also made announcements to strengthen its technological power and sovereignty to address the tension between increasing innovation and national security concerns.<sup>440</sup>

Greg Allen and Daniel Chen conducted a study at the Harvard Kennedy School's Belfort Center and released a report on artificial intelligence and national security. They give several key recommendations for the U.S. government. Some of these recommendations include:

- The DOD should conduct AI-focused war-games to identify potential disruptive military innovations.
- The DOD should prioritize AI R&D spending areas that can provide sustainable advantages and mitigate key risks.
- DARPA, IARPA, the Office of Naval Research, and the National Science Foundation should be given increased funding for AI-related basic research.
- The Department of Defense and Intelligence Community should establish dedicated AI-safety organizations.
- DARPA should fund research on failsafe and safety-for-performance technology for AI systems.<sup>441</sup>

Allen and Chen's recommendations are attempting to balance the tradeoff between the two. However, it is clear that as the U.S. tends to innovate more and implement EDTs into practice, there will inherently be more risks to national security. However, if the government significantly prioritizes national security over innovation, then the U.S. risks China emerging as a superpower in AI and other technologies, putting the U.S. at a strategic disadvantage.<sup>442</sup>

## The Intersection of Innovation, National Security, and Talent

All three of these attributes in AI policy (Innovation, National Security, and Talent) are related. It is clear that as you increase the amount of talent (foreign or domestic) in a country, the higher the national security risk. This is also true for innovation. The more innovation that occurs, the

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<sup>439</sup> Fjader, 2022.

<sup>440</sup> Ibid.

<sup>441</sup> Greg Allen and Daniel Chan. "Artificial Intelligence and National Security". *Harvard Kennedy School – Belfort Center*, 2017.

<sup>442</sup> Allen and Chan. "Artificial Intelligence and National Security". 2017.

more potential for vulnerabilities and less robust systems due to the introduction of new less reliable systems. However, more innovation can help improve national security when used correctly. For example, advances in cyber security technologies with improved AI in their systems can enhance national security. However, to do this, you need more talent. In order to get more talent, countries need to increase their talent pool through international acquisition, which in turn can hurt national security. The Venn Diagram below illustrates this paradox.

## INNOVATION, NATIONAL SECURITY, AND TALENT Venn Diagram

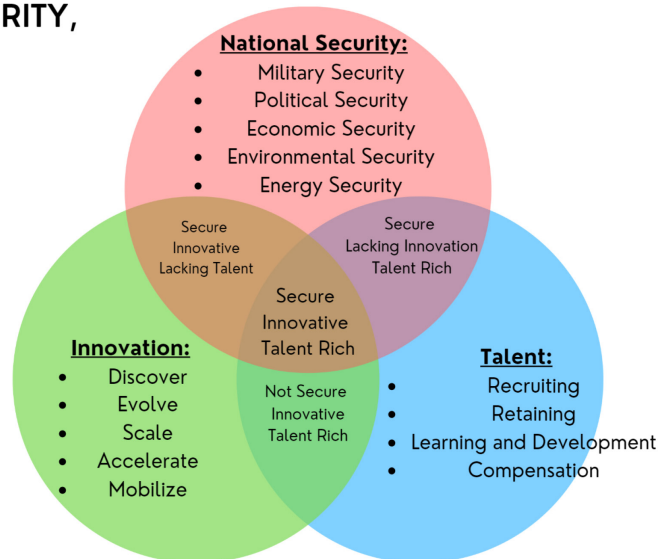


Figure 20. Venn Diagram - Innovation, National Security, and Talent.

This Venn diagram depicts how all three of these attributes in AI policy are interconnected on a broader scale. In an ideal world, the U.S. would be located in the “sweet spot”, where all three attributes intersect. However, this is very hard to achieve and thus why the U.S. among other nations mostly have to prioritize one or two of these attributes more.

Some argue that currently, the United States Department of Defense is located at the intersection between innovation and national security. The DOD has innovative processes and a strong national security; however, they are lacking talent compared to the private sector and other countries. The Heritage Foundation outlines how the DOD is struggling to retain and recruit talent.<sup>443</sup> They claim that the DOD’s hiring model is not working when it comes to jobs in the technology field such as cybersecurity.<sup>444</sup> The U.S. will attempt to move towards the intersection

<sup>443</sup> Elias Gavilan and James Di Payne. “Why the Military Is Losing the Battle for the Best, Brightest Cybersecurity Talent”. *The Heritage Foundation*, 2019.

<sup>444</sup> Gavilan and Di Payne. “Why the Military Is Losing the Battle for the Best, Brightest Cybersecurity Talent”. 2019.

of all three attributes moving forward to maximize the talent that currently exists in the United States and internationally as well.

### The Implicit Optimization Problems: Views on Tradeoffs

The section below outlines the tradeoffs that decision makers face when making AI policy decisions with these specific attributes. It is important to note that decision makers do not actually write these tradeoff analysis down and analyze them. Rather, policymakers view these tradeoff problems implicitly when they address the core issues. The section below simplifies the views of these tradeoffs to two views. There are many other variations of views; however, for simplicity, I will only use two views to contrast the opinions on the tradeoffs.

#### **Innovation vs Regulation:**

Innovation as a priority: “As a country, we will maximize innovation in AI subject to the constraint of a certain baseline level of minimum regulatory protection for our citizens”.

Consumer protection priority: “As a country, we will maximize the protection of our citizens through regulatory measures in the field of AI subject to the constraint of a certain baseline level of innovation”.

#### **Explainability vs Accuracy:**

Explainability as a priority: “As a country, we will maximize the explainability of our AI systems and algorithms subject to the constraint of a baseline level of accuracy.”

Accuracy as a priority: “As a country, we will maximize the accuracy of our AI systems and algorithms subject to the constraint of a baseline level of explainability”.

#### **Fairness vs Accuracy:**

Fairness as a priority: “As a country, we will maximize fairness in our AI systems and algorithms subject to the constraint of a baseline level of accuracy”.

Accuracy as a priority: “As a country, we will maximize the accuracy of our AI systems and algorithms subject to the constraint of a baseline level of fairness”.

#### **Privacy vs Accuracy:**

Privacy as a priority: “As a country, we will maximize privacy for our citizens data in our AI systems and algorithms subject to the constraint of a baseline level of accuracy”.

Accuracy as a priority: “As a country, we will maximize the accuracy of our AI systems and algorithms subject to the constraint of a baseline level of privacy for our citizens”.

#### **Privacy vs Fairness:**

Privacy as a priority: “As a country, we will maximize privacy for our citizen’s data in our AI systems and algorithms by adding restrictions subject to the constraint of a baseline level of fairness”.

Fairness as a priority: “As a country, we will maximize fairness in our AI systems and algorithms subject to the constraint of a baseline level of privacy”.

### **Attracting Talent Vs. National Security**

Attracting talent as a priority: “As a country, we will maximize our pool of talent by attracting the best STEM talent in the world subject to the constraint of a baseline security protocol to protect national security”.

National security as a priority: “As a country, we will maximize our national security interests by limiting the number of foreign citizens that can have access to and develop our technology subject to the constraint of baseline level of innovation that takes place from foreign talent”.

### **Innovation Vs. National Security**

Innovation as a priority: “As a country, we will maximize our innovation in emerging disruptive technologies (EDTs) subject to the constraint of a baseline security protocol to protect national security”.

National security as a priority: “As a country, we will maximize our national security interests by limiting the effect of EDTs, subject to the constraint of baseline level of innovation that takes place from foreign talent”.

### **Possible Solutions to Address These Tradeoffs?**

These tradeoffs in the field of AI do currently exist; however, in the future, improved technology can better address tradeoffs. Improved technology in the field of artificial intelligence can actually reduce the effects of these tradeoffs and help policy makers achieve more of a middle ground that maximizes both tradeoffs. For example, regression trees have been used to increase explainability in models. However, developing technologies in Fuzzy Regression Trees (FRTs) increases accuracy and explainability in ways that have not been explored before.<sup>445</sup> This is a great example of how innovation in specific AI technologies can improve the tradeoffs that stem from our current technologies.

However, it is important to realize that as we progress in the future and build more AI technologies, there will be future tradeoffs that arise. The current time of this work is at the end of the year 2022. By 2032, there will be new tradeoffs that do not exist now as a result of new AI technologies and practices. It is important to realize that the field of AI is rapidly changing every year. However, more innovation in the field of AI will continue to address the existing tradeoffs.

Advances in technology will be able address some of our current tradeoffs that we have today. However, with the advances in technology, new tradeoffs may arise. Although some tradeoffs will be addressed by technology and evolve, some tradeoffs will never change. The tradeoff between innovation and consumer protection will always be an issue. However, tensions like explainability vs accuracy may improve with better technology. Although new tradeoffs will arise, more innovation will enhance the well-being of our society.

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<sup>445</sup> Alessio Bechini; Jose Barcena; Pietro Ducange; Francesco Macelloni, and Alessandro Renda. “Increasing Accuracy and Explainability in Fuzzy Regression Trees: An Experimental Analysis”. *IEE*, 2022.

## Chapter 4- AI Policy Design Choices

“As positive as we are about AI, we’re also aware of its potential for unintended consequences. So, we must design, develop, and deploy AI with a huge amount of care to ensure everyone can benefit from these advances. After all, people will only use AI if they trust it.”<sup>446</sup>

- Cindy Rose, CEO of Microsoft UK

### AI Design Choices

Design choices in artificial intelligence policy are the components that drive a government’s AI strategy. Some examples of design choices in AI policy include government funding, innovation strategy, law, education, and ethics. Design choices are different from tradeoffs because design choices are the frameworks and strategies that drive AI policy as opposed to an analysis of AI policy features. Design choices fundamentally shape a government’s AI policy.

For example, the United States uses a vertical approach in their AI policy because the United States has a more decentralized style of government. Europe has an existing centralized government; therefore, it makes more sense for them to have a horizontal scope of laws. Design choices are the frameworks that drive AI policy, and each country has a unique set of design choices that drive their AI policy. Please refer to figures 20 through 21 at the end of chapter four for an in-depth analysis of all the design features in AI policy for 13 countries.

### Government Funding

The United States and China are funding more money into artificial intelligence than any other country, and the United States is starting to take a more centralized government funded approach to expedite the innovation in the field of AI.<sup>447</sup> The U.S. government will allocate money each year for organizations such as the National Science Foundation, National Institute of Standards and Technology, the Department of Energy and others to innovate artificial intelligence. Each organization will use the money to develop AI on their own.<sup>448</sup> Congress also has a large budget to fund universities in the United States. The government funds the National Science Foundation to distribute to universities. Additionally, the Department of Defense funds projects for universities as well.

In August of 2022, President Biden signed the CHIPS Act, which established investments and incentives to support U.S. semiconductor manufacturing, research and development, supply chain security, invests in research and development, science and technology, and artificial intelligence.<sup>449</sup> Not only does this Bill supply \$52 billion into U.S. semiconductor development,

<sup>446</sup> “From the Influencers - This Month’s Key Quotes from Leaders in Artificial Intelligence”. *Verdict AI*, 2022.

<sup>447</sup> “Funding and Investments! AI Investments By Top 10 Countries” *Analytics Insight*, 2022.

<sup>448</sup> “H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021”. 116th Congress, 2020.

<sup>449</sup> “CHIPS and Science Act of 2022”. The United States Congress, 2022.

but it also supplies over 13 billion dollars to enhance STEM fields through more research and development and public sector integration.<sup>450</sup>

Although the majority of the funding will be geared toward semiconductor and chip development in the United States, the CHIPS Act of 2022 invests significant funds into the field of artificial intelligence. This act authorizes \$10 billion dollars to invest in regional innovation and technology hubs across the country.<sup>451</sup> The CHIPS Act is aiming to bring together the public sector, private sector, and academia to innovate for artificial intelligence in local hubs.

The CHIPS Act (which was inspired in part by the work “Jump-Starting America”), is attempting to bolster innovation in STEM fields through a regionalized public-private partnership with the aid of local universities.<sup>452</sup> This is one of the largest spending bills since the start of the 21<sup>st</sup> century on technology. Other countries such as China are starting to catch up to the United States in technology innovation; therefore, the U.S. government has decided to fund research and development in the field of technology to bolster innovation.

The Peoples Republic of China (PRC) allocates their funding in local approach to be distributed through local municipalities and provinces. The local governments for the most part are driving growth in China.<sup>453</sup> Local governments in China have established AI innovation centers in Beijing, Shenzhen, Hangzhou, and Nanjing that are highly competitive AI markets (Kai-Fu Lee, 2018). The United States has actually moved towards a funding strategy in a similar way. Although China relies on more local municipalities and provinces to drive the growth as opposed to the U.S. federal government allocating the funds, the U.S. has taken a more “local hub” approach in terms of innovation for AI.

The biggest difference between the U.S. funding approach and China, is that the PRC is driving AI innovation through collective measures as opposed to the traditional U.S. private sector innovation model with government support. China’s government will control all growth and continue to enhance AI capabilities; however, will allow the local governments flexibility to reward companies and fund specific programs. China has 17 national-level innovation demonstration zones, which were selected by the State Council and enjoy favorable policies to encourage innovation and regional economic growth.<sup>454</sup> China will continue to encourage competition among local zones to promote innovation.

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<sup>450</sup> “FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”. The White House Briefing Room, 2022.

<sup>451</sup> “FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”. 2022.

<sup>452</sup> Ashleigh Maciolek and Ben Olinsky. “The CHIPS and Science Act Will Boost Competitiveness and Promote Inclusive Growth”. *CAP*, 2022.

<sup>453</sup> Kai-Fu Lee. “AI Superpowers: China, Silicon Valley and the New World Order”. *Marinar Books*, 2018.

<sup>454</sup> Alberto Arenal; Cristina Armuña; Claudio Feijoob; Sergio Ramos; Zimu Xu; Anna Moreno. “Innovation ecosystems theory revisited: The case of artificial intelligence in China”. *Telecommunications Policy*; Vol. 44, ISS. 6, 2020.



China stated in their generational artificial intelligence plan that they plan to construct a cooperative AI technology system, whereas the U.S. has taken a centralized funding approach with the passing of the CHIPS Act.<sup>455</sup>

The United Kingdom's centralized funding strategy is similar to the United States. The UK government has allocated millions of pounds each year to organizations such as the NHS lab, Centre for Connected and Autonomous Vehicles, and doctoral/masters programs in their education system.<sup>456</sup>

The European Union is taking a different approach than all these countries. The European Union is funding different sectors of AI; however, funding is not their main priority. Europe's top priority is to protect their consumers and Europe has shown they are willing to sacrifice innovation to achieve their goals. They are using their funding to regulate AI and ensure that people's rights are protected.<sup>457</sup> The EU is leaving the majority of the funding allocations to individual countries in Europe.

Overall, the United States is starting to shift their model from a reliance on the private sector for innovation, to a more publicly funded research and development model. The CHIPS Act shows that the United States is moving in a direction that replicates the growth in the United States after World War Two. After World War Two, the United States emerged as the world leader in innovation through programs like the National Science Foundation, the Apollo Missions, DARPA, and the National Institutes of Health.<sup>458</sup> The private sector would have not been likely to take on large projects like the Apollo missions due to the risks it poses. The U.S. is starting to shift their model to that of the model for innovation from 1945-1970. The CHIPS act is a step in that direction as the government is getting more involved in AI innovation and is creating an environment of innovation that is starting to look similar to the U.S. government in the post-World War Two era.

## Innovation

There is a significant difference between the two AI superpowers (The U.S. and China) in their approach to innovation and government intervention. In China, local government leaders incentivize a competitive AI environment for top companies to emerge with innovative AI products.<sup>459</sup> Local governments will reward companies and entrepreneurs who innovate and develop cutting edge AI.<sup>460</sup>

Before the passage of the CHIPS Act, the United States government took a hands-off approach that allowed the private sector to develop AI and funded the NSF to spur innovation in academia.

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<sup>455</sup> "New Generational Artificial Intelligence Development Plan (Stanford Translation)". *People's Republic of China (Stanford Translated Edition)*. 2017.

<sup>456</sup> "National AI Strategy". *Parliament of the United Kingdom*, Sep. 2021.

<sup>457</sup> "A Proposal for a Regulation of The European Parliament and of the Council. Laying Down Harmonized Rules on Artificial Intelligence and Amending Certain Union Legislative Acts." *European Commission*. Brussels, 2021.

<sup>458</sup> Jonathan Gruber and Simon Johnson. "Jump-Starting America". *Public Affairs – Hachette Book Group*, 2019. New York.

<sup>459</sup> Kai-Fu Lee. "AI Superpowers: China, Silicon Valley and the New World Order". *Marinar Books*, 2018.

<sup>460</sup> Lee, 2018.

The public and private sector did not have many programs where they worked together to develop AI. American private sector stakeholders said that government funded innovation zones are inefficient and a waste of taxpayer dollars.<sup>461</sup> In the minds of many Silicon Valley's entrepreneurs, the best thing the federal government can do is leave them alone.<sup>462</sup>

However, as of late, the United States has seen China's capabilities in the field of AI start to catch the U.S. Therefore, the U.S. government is starting to play a more active role in the innovation and development of AI in the United States. The U.S. is starting to take a more federally funded research approach to develop AI, with the support of the private sector and academia. The U.S. sees AI as a strategic and essential capability moving forward; therefore, the government is starting to take a larger role in the development of AI than previously before the CHIPS Act which was passed in August of 2022.

Most countries' plan for innovation follows the blueprint of how each country innovates other areas as well. Canada is taking an interesting approach to their innovation. Canada plans to recruit the world's top talent in the field of AI. They plan to put foreign citizens through masters and PhD programs in AI to increase their capabilities. Countries with smaller populations, such as the Netherlands are taking the same approach to innovate. Canada, the Netherlands, and United Arab Emirates are all trying to set the right conditions to appeal to foreign AI talent.<sup>463</sup>

Countries with larger populations like the United States, China, and France, plan on using their own talent. France states in their AI policy that they will bet on their own talent and pool their assets to innovate for AI. France clearly believes they have the resources and personnel they need in France to innovate.<sup>464</sup> The United States already has a lot of foreign talent at companies and universities; therefore, they do not need to develop a plan to attract more foreign talent. China is also betting on their capabilities and plan to innovate within their country.<sup>465</sup>

Japan is taking one of the more unique approaches to fund for AI. Japan plans to use start-ups and universities to promote innovation in AI. They will promote R&D projects based on Industry-Academia-Government Collaboration. They state that it is necessary to carry out environmental development and utilize data that is linked to social needs, such as in the sectors of health, medical care, welfare, transportation, agriculture, forestry, and fisheries.<sup>466</sup> Japan has stricter laws when it comes to international talent, and they are attempting to curate more domestic talent.

Australia is taking a unique approach to innovating their AI as well. Australia is not using a decentralized method or a government top-down approach to develop AI. Rather, Australia is innovating specific areas in their AI development. Australia is specializing their AI innovation in

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<sup>461</sup> Ibid.

<sup>462</sup> Ibid.

<sup>463</sup> "The Pan-Canadian AI Strategy". *CIFAR*, 2017.

<sup>464</sup> "AI For Humanity". *Parliament of France*, 2018.

<sup>465</sup> "New Generational Artificial Intelligence Development Plan (Stanford Translation)". *People's Republic of China (Stanford Translated Edition)*. 2017.

<sup>466</sup> "Artificial Intelligence Technology Strategy (Report of Strategic Council for AI Technology)". *Japan Strategic Council for AI Technology*, Mar 2021.

specific areas such as agriculture, small businesses enterprise development, and the medical field.<sup>467</sup>

Lastly, the United Arab Emirates have one of the most aggressive AI innovation plans. They are actively trying to recruit the best talent to the UAE through their UAE AI seal program.<sup>468</sup> The UAE is developing a UAE AI Seal brand and will use this to attract talent and business from across the globe to come to the UAE to test and develop AI. Compared to other countries, the United Arab Emirates is prioritizing AI innovation more than other countries. The UAE believe they need to catch the top AI powers in the world and bet on AI.<sup>469</sup> The UAE is also the only country to have created a university that exclusively innovates artificial intelligence. Their AI policy is ambitious, and we will see if the UAE starts to catch countries like The United States, China The UK, and Europe in AI capabilities.

## The Binding of Laws (Voluntary and Non-Voluntary)

Each country either has a voluntary or non-voluntary system regarding their regulations and laws. A country with a voluntary system does not require their companies or individuals to follow specific laws and guidelines; however, they give countries ethical guidance and recommendations to employ safe AI. Countries that have non-voluntary systems require their citizens and companies to follow the regulations they have created. Countries with non-voluntary systems will fine and punish organizations that break the existing laws. Voluntary systems differ because governments will not fine or punish organizations that do not follow their guidance.

The European Union is developing one of the most comprehensive non-voluntary frameworks in the world. The EU has stated that high-risk AI systems shall be tested for the purposes of identifying the most appropriate risk management measures. In their newest AI regulation doctrine, they state, “Testing shall ensure that high-risk AI systems perform consistently for their intended purpose, and they follow the requirements set out by the EU”. The EU will also test the data and governance that a given AI system uses to ensure it follows the regulation. A high-risk AI system must also have technical documentation and record keeping ensuring that it does not violate the regulation.

In the EU, if an offender violates the established rules and regulations, they shall be subject to administrative fines of up to 30,000,000 EUR or, if the offender is a company, up to 6 % of its total worldwide annual turnover for the preceding financial year, whichever is higher. Additionally, they state, the non-compliance of the AI system with any requirements or obligations under this regulation, other than those laid down in Articles 5 and 10, shall be subject to administrative fines of up to 20,000,000 EUR or, if the offender is a company, up to 4 % of its total worldwide annual turnover for the preceding financial year, whichever is higher.<sup>470</sup>

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<sup>467</sup> “Artificial Intelligence: Solving Problems, Growing the Economy, and Improving our Quality of Life”. *Australian Parliament*, 2020.

<sup>468</sup> “UAE National Strategy for Artificial Intelligence 2031”. *United Arab Emirates Minister of State for Artificial Intelligence, Digital Economy, and Remote Work Application Office*, 2019.

<sup>469</sup> “UAE National Strategy for Artificial Intelligence 2031”. 2019.

<sup>470</sup> “A Proposal for a Regulation of The European Parliament and of the Council. Laying Down Harmonized Rules on Artificial Intelligence and Amending Certain Union Legislative Acts.” *European Commission*. Brussels, 2021.

China has a similar system compared to the EU. The PRC has outlined guidance for their companies to follow. Although these guidelines are sometimes vague and allow for the PRC to interpret the laws in the manner they feel. China's Internet Information Service Algorithmic Recommendation Management Provisions state, "Where organizations or individuals conducting data handling activities do not perform the data security protection obligations the relevant departments in charge are to order corrections and give warnings and may also impose a fine of between 50,000 and 500,000 Yuan, and a fine of between 10,000 and 100,000 Yuan on directly responsible management personnel and other directly responsible personnel".<sup>471</sup>

Most other countries have a voluntary system. The theory behind a voluntary system is that with the fast pace of innovation in the field of AI, it is too difficult to draft a policy that punishes individuals and companies for breaking guidelines. The United States government has developed a Subcommittee on Artificial Intelligence in attempt to facilitate a more ethical deployment of AI. This agency promotes the fair use of AI and provides advice to the President on matters relating to the development of AI but does not actively punish or fine companies and individuals who violate their guidelines.<sup>472</sup>

The subcommittee provides advice to congress and the president on matters relating to bias, security of data, adoptability, and legal standards.<sup>473</sup> There are currently no fines or sanctions for companies or individuals who break these guidelines. Many other countries take a similar approach. It is important to note that countries like France and the Netherlands do not need to draft a non-voluntary frameworks because the European Union has already developed one.

The benefit of the non-voluntary system is that it helps to promote the government's agenda because companies are forced to comply with the government's laws and expectations or else, they will face punishments. However, the drawback with non-voluntary systems is that artificial intelligence is moving at such a fast pace, it is hard for governments to make accurate laws. It also does not allow for AI to develop in nontraditional ways. Some of the biggest breakthroughs in AI have come from experimentation and the mindset of, "let's see what happens if we try this". In a non-voluntary system, it is harder for companies and individuals to be creative and experiment in new fields of AI.

The voluntary system allows for more creativity and areas of research to occur because they are not binded by a set of rules or objectives from the government. The benefit of a voluntary system is that governments do not have to keep creating laws that address the current state of AI. Artificial Intelligence was much different in 2017 than it is in 2022. Governments could be wrongfully punishing companies or moving the private sector in the wrong direction based on their outdated non-voluntary requirements.

One drawback of voluntary systems is that it is easier for companies to use unethical AI, and governments have less control. Since there are no real consequences for companies who do not

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<sup>471</sup> "Internet Information Service Algorithmic Recommendation Management Provisions" *People's Republic of China (Stanford Translated Edition)*, Sep. 2021.

<sup>472</sup> "H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021". 116th Congress, 2020.

<sup>473</sup> "H.R.6395 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021". 2020.

follow the guidance, they do not feel as obligated to follow them. Countries who have voluntary systems are starting to create task forces to investigate companies that may be using unethical AI. However, they still run the risk of companies manipulating the system and using unethical AI.

## Scope of Laws (Horizontally and Vertically)

There are two ways that a country can integrate their laws and regulations; vertically or horizontally. A vertical scope of laws has sector specific regulations for AI systems. A horizontal scope of laws does not have industry specific regulations, rather every AI system has the same blanket regulations. The existing structure of a country's regulatory approach to enforce laws plays a large role in this decision.

Most countries have a horizontal scope for their AI laws. The same regulatory standards apply to all sectors in their society. Europe could not have their extensive AI regulatory framework with a vertical scope for their laws. It would be too difficult to regulate sector specific AI systems to the extent that they want. Therefore, they have a "blanket" regulatory framework that applies to all industries. China and Japan have a horizontal framework to increase government control in the field of AI. Although a lot of the innovation occurs at the local level in China, the PRC wants to dictate growth and be significantly involved in AI; therefore, a horizontal implementation of laws suits their needs better.

There are only a few countries that have a vertical scope of their AI laws. The United States for example, already has many of their laws implemented vertically. The U.S. has sector-specific laws in place, so it makes sense for the U.S. to continue the vertical scope of laws when it comes to AI. Vertical scope of laws allows countries like the U.S. to innovate sector specific technologies better. With no "blanket" regulatory framework, the U.S. can innovate and address sector specific technologies better.

With horizontal frameworks, some laws do not apply as well in certain industries compared to others, which makes it difficult to not only innovate sector-specific technologies, but also to regulate sector specific technologies effectively. The United States, the United Kingdom, and Canada are some of the few countries that use a vertical scope of their laws. The United States has a decentralized system, and a horizontal scope of an AI regulatory framework would be detrimental to innovation and privacy in the United States. These countries prioritize industry specific regulations that allow for flexibility.

With a vertical scope of laws, it is much easier for the government to make industry specific laws. The government can make the requirements different in the finance industry compared to the healthcare industry. It allows for flexibility within the AI regulatory framework. The drawback to vertical scope of AI laws is that there is no set standard for every AI system. It allows for more manipulation and bias to occur because there is no standard across the board.

Horizontal scope of laws addresses this issue. A horizontal approach allows the government to have more control over all AI systems. They can regulate them all the same and there is a set standard in the regulatory framework. The drawback to horizontal scope is that different

industries need different regulations. The finance industry uses AI much differently than the healthcare industry and they need to have laws to address the differences.

Many countries are transitioning to the horizontal framework because it allows for the government to regulate AI better and more consistently. Artificial intelligence is a general-purpose technology, and therefore more countries are starting to address AI laws the same in every industry. It also allows for the governments to promote their goals in a more effective manner. Horizontal scope gives the government more control and they can set the standard. So, if the government's goal is to promote innovation, it can set standards to enhance innovation. If the government is more concerned with the ethical deployment of AI, then they can set the standard for all AI systems to promote the ethical use of AI.

## The Specificity of Laws

Most countries have definitions for their terms and are clear in their laws. In the introduction section for most country's AI policies, it clearly defines terms such as artificial intelligence, ethical, etc. Most countries explicitly state what is illegal, what is allowed, and how the government will address issues if companies or individuals break the law.

However, China is relatively vague in their definitions and rules in their AI policy. For example, China's AI policy states, "Algorithmic recommendation service providers shall uphold mainstream value orientations, optimize algorithmic recommendation service mechanisms, vigorously disseminate positive energy, and advance the use of algorithms upwards and in the direction of good."<sup>474</sup> Algorithmic recommendation service providers may not use algorithmic recommendation services to engage in activities harming national security, upsetting the economic order and social order, infringing the lawful rights and interests of other persons, and other such acts prohibited by laws and administrative regulations."<sup>475</sup>

China uses phrases such as "vigorously disseminate positive energy", "advance the use of algorithms upwards in the direction of good", and "upsetting the economic order and social order". What does "vigorously disseminate positive energy" mean? These statements can be used to address many different situations to suit the needs of the government are extremely vague. China deliberately uses these vague terms and phrases so the government can use the law to its own convenience. The vagueness allows the PRC to interpret their laws in many ways based on the scenario. The vagueness of China's laws gives the PRC more power and opportunities to make scenario-based decisions.

Aside from China, most countries are more specific with their AI laws to increase clarity that hold the government to a specific standard. European countries and the United States are very specific with their terms and laws. They do not have clauses like "upsetting the social order" or "upwards in the direction of good" in their AI policies because phrases like these are extremely vague. It allows governments to interpret the law on a case-by-case basis and manipulate their

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<sup>474</sup> "Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022". *The People's Republic of China (Stanford Translated Edition)*, 2021.

<sup>475</sup> "Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022". 2021.

population. What is “upsetting the social order” in one scenario may not be in another. This is a highly criticized portion of China’s AI policy.

## Regulatory Framework – Inputs or Outputs?

Countries like the United States and United Kingdom are regulating the outputs of AI systems.<sup>476</sup> Therefore, the U.S. and UK only analyze the predictions of AI systems (or outputs). The European Union is taking a much different approach. They are regulating the inputs (or data) of AI systems.<sup>477</sup> The EU’s theory is that if the data is clean and unbiased, the output cannot be unbiased. Kenya has a different philosophy than most other countries. Rather than focusing on regulating the inputs or outputs, they are regulating the distribution of data.<sup>478</sup>

Many emerging countries have the same viewpoint as Kenya when regulating the distribution of data. China also differs from other countries because they regulate both the inputs and outputs of systems.<sup>479</sup> The PRC wants to have a lot of control over AI in the private sector; therefore, they regulate both inputs and outputs in AI systems. As we progress, it will be likely that most countries will need to regulate both inputs and outputs. The data needs to be clean and fair, and the output needs to also reflect the data. There are opportunities for ethical violations to stem from both the inputs and outputs of systems; therefore, in the future, companies and governments will be monitoring both inputs and outputs.

## Education

The United Arab Emirates is the first country to create a university that is specifically designed for development in AI. This university is called the Mohamed Bin Zayed University of Artificial Intelligence college.<sup>480</sup>

Many countries have included plans to fund and develop educational programs into their AI policy framework. The United Kingdom has funded over 100 million pounds into AI centers for doctoral training in AI. They plan on delivering over 1,000 PhDs and 2,500 master’s degrees over the next five years. The United Kingdom has also funded 46 million pounds in support of the Turing AI fellowships to develop talent in AI for the next generation.<sup>481</sup>

In addition to European countries, Japan and Canada are both using academia to promote AI development. Japan plans to use start-ups and universities to promote innovation in AI. They will promote R&D Projects Based on Industry-Academia-Government collaboration. Canada funds

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<sup>476</sup> “Division E - National Artificial Intelligence Initiative Act of 2020”. *United States Congress*. 2020.

And “National AI Strategy”. *Parliament of the United Kingdom*, Sep. 2021.

<sup>477</sup> “A Proposal for a Regulation of The European Parliament and of the Council. Laying Down Harmonized Rules on Artificial Intelligence and Amending Certain Union Legislative Acts.” *European Commission*. Brussels, 2021.

<sup>478</sup> Nanjala Nyabola. “Old Cracks, New Tech: Artificial Intelligence, Human Rights and Good”. *University of Oxford*, 2021.

<sup>479</sup> “Translation: Internet Information Service Algorithmic Recommendation Management Provisions – Effective March 1, 2022”. *The People’s Republic of China (Stanford Translated Edition)*, 2021.

<sup>480</sup> “UAE National Strategy for Artificial Intelligence 2031”. *United Arab Emirates Minister of State for Artificial Intelligence, Digital Economy, and Remote Work Application Office*, 2019.

<sup>481</sup> “National AI Strategy”. *Parliament of the United Kingdom*, Sep. 2021.

three national AI Institutes — Amii in Edmonton, Mila in Montreal, and the Vector Institute in Toronto, as well as universities, hospitals, and organizations across the country to innovate AI.<sup>482</sup>

China has outlined policies to innovate their AI capabilities through education. China contrasts with many other countries because they explicitly state in their AI policy that they plan to educate primary and secondary students on AI topics. It is clear that China is investing in their younger generation to promote AI innovation.

The United States government funds more money into universities than any other country. The U.S. National Science Foundation announced the establishment of 11 new NSF National Artificial Intelligence Research Institutes, building on the first round of seven institutes funded in 2020. The combined investment of \$220 million expands the reach of these institutes to include a total of 40 states and the District of Columbia.<sup>483</sup>

The NSF will be focusing their funds and developments in seven areas: human-AI interaction and collaboration, AI for advances in optimization, AI and advanced cyberinfrastructure, AI in computer and network systems, AI in dynamic systems, AI-augmented learning, AI-driven innovation in agriculture, and the food system.<sup>484</sup>

The NSF is using both private and public sector organizations to innovate AI in universities. The NSF and Amazon are partnering to jointly support research focused on fairness in AI, with the goal of contributing to trustworthy AI systems that are readily accepted and deployed to tackle grand challenges facing society. Specific topics of interest include, but are not limited to, transparency, explainability, accountability, potential adverse biases and effects, mitigation strategies, validation of fairness, and consideration of inclusivity.<sup>485</sup>

Additionally, the NSF partners with public institutions, such as the Defense Advanced Research Projects Agency (DARPA). The NSF and DARPA have teamed up to explore high-performance, energy-efficient hardware and machine learning architectures that can learn from a continuous stream of new data in real time. Both agencies issued calls for proposals focused on real-time machine learning and are now offering collaboration opportunities to awardees from both programs throughout the duration of their projects.

This partnership is contributing significantly to the foundation for next-generation co-design of algorithms and hardware.<sup>486</sup> The United States has leading universities in the field of AI such as MIT, Stanford, Carnegie Mellon, Harvard, and California Berkley. Other countries do not have universities that can compete with the U.S. and many international students decide to study at U.S. universities.

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<sup>482</sup> “The Pan-Canadian AI Strategy”. *CIFAR*, 2017.

<sup>483</sup> “Artificial Intelligence at NSF”. *The National Science Foundation*, 2021.

<sup>484</sup> “Artificial Intelligence at NSF”. 2021.

<sup>485</sup> *Ibid.*

<sup>486</sup> *Ibid.*



## Ethical Baselines

Most countries have accepted the OECD Artificial Intelligence value-based principles. These principles include inclusive growth, human-centered values, transparency, robustness, and accountability.<sup>487</sup> Although most countries mention these values in the AI policy, some countries have gone to further extents to ensure that AI reflects these principles.

UNESCO was one of the first global organizations to set a standard for the ethical use of AI. UNESCO stresses for data protection and calls for more action from regulatory bodies.<sup>488</sup> UNESCOs ethical framework bans invasive AI for social scoring and mass surveillance.<sup>489</sup> Additionally, UNESCO work on AI spans across the world and has launched its guidance for policy makers in AI and education, developed training for youth on AI, and will be training over 2,000 judicial operators worldwide on AI and the rule of law.<sup>490</sup>

The European Union and European countries are maximizing human rights and fairness in AI systems subject to a baseline level of innovation. The European Union has the most in-depth framework to protect the rights and privacy of citizens. There are tradeoffs with ensuring this amount of privacy. The United States, United Kingdom, and Canada have similar approaches to ensuring the OECD value-based principles; however, they are maximizing innovation in AI subject to a minimum baseline level of protection.

Although many believe that China does not prioritize privacy and fairness, new Chinese laws and provisions clearly depict that this claim is not entirely true. The PRC's algorithmic recommendations also says where organizations or individuals conducting data handling activities do not perform the data security protection obligations the relevant departments in charge are to order corrections and give warnings and may also impose a fine. Additionally, China's privacy laws state, where core national data management systems are violated, endangering national sovereignty, security, or development interests, relevant departments in charge are to impose a fine.<sup>491</sup> China may view privacy slightly differently than western countries; however, they still have frameworks that enhance privacy and ethical rights for citizens in China.

Kenya has greater challenges to ensure that AI is used in an ethical manner because of corruption issues in the past. Data sovereignty is important for countries like Kenya. Kenya is willing to forfeit much of its innovation to ensure data is not manipulated in their country. Kenya is deploying AI in highly fragmented societies risks deepening existing cleavages.<sup>492</sup> Kenyan leaders have stated that with a mixed record on government-led involvement in technology, it is important to recall that technology is political, that is, it is intimately connected to power

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<sup>487</sup> "OECD AI Principles". *OECD*, 2021.

<sup>488</sup> "UNESCO adopts first global standard on the ethics of artificial intelligence". *UNESCO*, 2021.

<sup>489</sup> "UNESCO adopts first global standard on the ethics of artificial intelligence". 2021

<sup>490</sup> *Ibid.*

<sup>491</sup> "Translation: Data Security Law of the People's Republic of China" *People's Republic of China (Stanford Translated Edition)*, Sep 2021.

<sup>492</sup> Nanjala Nyabola. "Old Cracks, New Tech: Artificial Intelligence, Human Rights and Good". *University of Oxford*, 2021.

relations between various actors. Kenya is looking to ensure that their citizens are protected, and citizens in Kenya are not exploited from unethical AI.<sup>493</sup>

## Military Innovation

The United States has a clear mission and plan to fund AI in their military through research and development. The United States also created the Cyber Branch in their Army in 2017 to defend against cyber-attacks and use of malicious AI in the military. The United Kingdom and France has also invested in cyber security defense systems that use AI. The European Union has been focusing on developing their robotics in the military domain.

In 2020, the United States Army's budget for programs leveraging artificial intelligence and machine learning peaked at \$1.1 billion in 2020.<sup>494</sup> The Department of Defense's Research, Development, Test, and Enhancement (RDT&E) and Procurement budget requests \$969 million in the year 2022 that the Army plans to spend on programs with an artificial intelligence or machine learning component.<sup>495</sup> The top AI military funded programs in the United States include High Performance Computing Modernization Program, Future Unmanned Aircraft System (FUAS), and Information and Networking.<sup>496</sup>

In the Department of Defense Artificial Intelligence (DOD AI) Strategy, the network of U.S. allies and partners offers an "asymmetric strategic advantage" that no competitor or rival can match.<sup>497</sup> The Joint Artificial Intelligence Center (JAIC) has built on the DOD AI Strategy with three pillars of international AI engagement: "shaping norms around democratic values, ensuring data interoperability and working to create pipelines to enable the secure transfer of technology." In its recommendations to the executive branch and Congress, the National Security Commission on Artificial Intelligence (NSCAI) has also expanded on how to achieve this aim through a "coalition of coalitions" approach to technology cooperation.<sup>498</sup>

The United States Deputy Defense Secretary, Kathleen Hicks stated in her secretary address, "We want to harness from the very best of America in sourcing a broad, diverse set of potential partners and suppliers. That especially includes small businesses".<sup>499</sup> Small businesses lead the nation in innovation by producing 16.5 times more patents than large patenting firms. The U.S. government will look to work with small businesses to help improve the capabilities of AI in the U.S. She additionally stated that U.S. universities and research groups will lead the way to more innovation in the United States Military.<sup>500</sup>

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<sup>493</sup> Nanjala Nyabola. "Old Cracks, New Tech: Artificial Intelligence, Human Rights and Good". 2021.

<sup>494</sup> Alex Rossino. "FY 2022 Army Investment in Artificial Intelligence and Machine Learning". *GovWin*, 2021.

<sup>495</sup> Rossino. "FY 2022 Army Investment in Artificial Intelligence and Machine Learning". 2021.

<sup>496</sup> Rossino. 2021.

<sup>497</sup> Zoe Stanley-Lockman. "Military AI Cooperation Toolbox Modernizing Defense Science and Technology Partnerships for the Digital Age". *Georgetown University*, 2021

<sup>498</sup> Stanley-Lockman. "Military AI Cooperation Toolbox Modernizing Defense Science and Technology Partnerships for the Digital Age". 2021.

<sup>499</sup> Terri Cronk. "Hicks Announces New Artificial Intelligence Initiative". *DOD News*, 2021.

<sup>500</sup> Cronk. "Hicks Announces New Artificial Intelligence Initiative". 2021.

As of 2022, China is currently funding a significant amount of money into the use of AI in their military. Chinese military leaders are already prepared to employ and develop AI-related systems and equipment to prepare to “intelligentized” warfare.<sup>501</sup> It is likely that China has spent more than \$1.6 billion each year in the past five years on the Chinese People’s Liberation Army (PLA) for AI related systems and equipment.<sup>502</sup> Chinese leaders view AI as a way to transform China into a world class globally competitive military force. PLA AI advancements in will create new vulnerabilities for the U.S. and other allied countries around the world.

Overall, one of the PLA’s largest objectives is, to erode the U.S. advantage in undersea warfare and to jam U.S. sensor and communication networks. These aspirations are particularly relevant for U.S. policymakers and defense planners as they respond to mounting Chinese threats to Taiwan and other partners in the Indo-Pacific.<sup>503</sup> Additionally, the PLA may have been using generative language models to synthesize and amplify content on Facebook and Instagram, especially during election cycles.<sup>504</sup> China is starting to integrate AI into their operations, and they attempt to influence other countries and degrade U.S. capabilities with AI.

The Deputy Defense Secretary, Kathleen Hicks has responded to many of China’s objectives and stated that China is the United States long-term, pacing challenge in the field of AI because of its increased military confidence, willingness to take risks and China's adoption of a coercive and aggressive approach to the Indo-Pacific region (Cronk, 2021). Kathleen Hicks is establishing China as the United States long-term threat in the field of AI, and she is leading the United States effort to improve the capabilities of U.S. AI.

Although China may be investing similar amounts of money compared to the U.S. into AI military capabilities, one advantage the U.S. has, is that the United States often works in with other allies and China often does not work with many other countries (Stanley-Lockman 2021). The United States has joined 12 other counties, to include Australia, Canada, Denmark, Estonia, Finland, France, Israel, Japan, Norway, the Republic of Korea, Sweden, and the United Kingdom to meet in partnership to discuss AI capabilities and Defense.<sup>505</sup> There is an AI military competition between the United States and China, and these two countries are leading the world in AI military capabilities.

## Government-Private Sector Trust

The Chinese has an unusual relationship with some of its top private sector leaders in the field of Artificial Intelligence. The Chinese government has cracked down on larger companies, like Jack Ma’s Alibaba and Ant Financial.<sup>506</sup> The Chinese government significantly regulated Ma’s company and damped his assets. Ant Group and Alibaba extensively used AI to better their business and emerge in China as a massive company. Jack Ma was the richest man in China in

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<sup>501</sup> Alex Stephenson and Ryan Fedasiuk. “How AI Would – And Wouldn’t – Factor into a U.S. – Chinese War”. *Texas National Security Review*, 2022.

<sup>502</sup> Stephenson and Fedasiuk. “How AI Would – And Wouldn’t – Factor into a U.S. – Chinese War”. 2022.

<sup>503</sup> <sup>503</sup> Stephenson and Fedasiuk, 2022.

<sup>504</sup> Ibid.

<sup>505</sup> Terri Cronk. “Hicks Announces New Artificial Intelligence Initiative”. *DOD News*, 2021.

<sup>506</sup> George Calhoun. “The Sad End of Jack Ma Inc.”. *Forbes*, 2021.

2020 and Alibaba alone was worth more than any U.S. company except for Apple, Amazon, and Google.<sup>507</sup> Beijing is now slicing up Alibaba and Ant Groups assets of Ma's business to new partners of its choosing, to include some questionable and financially unstable companies in China.<sup>508</sup>

In 2021, the Chinese government stepped in and squashed Ant Groups IPO on the New York Stock Exchange. Ant Financial was expected to be the largest IPO in history (Calhoun, 2021). The Chinese government wanted to regulate Ant Financial as a bank to make it more subject to Chinese Law. After the Chinese government put these regulations into place, Ant's business was thrown into reverse, shrinking 18% in the first quarter in 2021, and down almost 50% from its peak in 2020.<sup>509</sup>

However, China most importantly wanted Ant Financial and Alibaba's data. Beijing aimed to gather data from both Ant and Alibaba so it can use it for future use. Alibaba and Ant had records and data from over 1 billion people.<sup>510</sup> Lastly, China deleted Jack Ma's internet browser, UC Browser, which had significant effects on Alibaba's business. The Chinese government is starting to trust the private sector much less than before. Large tech companies that are using AI to get an upper hand, like Ma's Alibaba and Ant group are being subject to strict Chinese law and regulation. The Chinese government has their eye on one of the most powerful assets the private sector can provide, data.

The United States has historically had a better relationship between the private sector and the government. The United States uses many private sector companies to partner with public institutions and the federal government. However, many of the tech giants in the United States who are using AI to dominate the market, are being questioned by Congress and antitrust laws are on the table. Historically, the United States has had a good public-privates sector relationship; however, we see that relationship start to erode today.

Rep. David N. Cicilline (D-R.I.), the chairman of the antitrust panel in the U.S. congress, opened a congressional investigation of Amazon, Apple, Facebook, and Google in 2019, aiming to explore whether the tech industry's most influential companies had attained their status through potentially anti-competitive means.<sup>511</sup> Many Democrats in Congress are aiming to apply antitrust laws to large companies.

Many Republicans in the United States congress are attacking large tech companies for abusing censorship. After January 6<sup>th</sup>, 2021, Twitter, Facebook, and many other large tech companies banned former President Donald Trump from their platforms. YouTube has also been very active in regulating Donald Trump's actions and will even remove podcasts and interviews with the former President present in them. Conservatives are aiming to regulate big tech and their ability to censor companies and people. Although the United States may have a better history with their

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<sup>507</sup> Calhoun. "The Sad End of Jack Ma Inc.". *Forbes*, 2021.

<sup>508</sup> Calhoun. "The Sad End of Jack Ma Inc". 2021

<sup>509</sup> Calhoun, 2021

<sup>510</sup> Ibid.

<sup>511</sup> Tony Room. "Amazon, Apple, Facebook and Google grilled on Capitol Hill over their market power". *The Washington Post*, 2020.

private sector – government relationship than China, the U.S. government and large tech companies are constantly at battle.

## Priorities

Each country clearly has priorities that they are attempting to curate and develop. The United States main priority is to keep innovating AI while addressing ethical AI with oversight. The U.S. aims to remain the leading innovator in the field of AI and are attempting to widen the gap with China as China starts to close in on U.S. AI in terms of capabilities. China is betting on AI and attempting to have the world’s most powerful AI. They are prioritizing AI innovation and digitizing their country. The European Union is concerned with human rights and abusive use of AI. The EU’s objective is to protect their citizens from unfair and biased AI. Many European countries are following suit.

Australia has a unique priority. They are prioritizing specialization in AI. They are specializing in agriculture, small businesses enterprise development, and the medical field. This contrasts a country like Brazil because Brazil’s focus is to develop trustworthy AI. They are not trying to specialize like Australia, rather they are focused on developing trustworthy AI in all sectors.

France also has interesting priorities. France wants AI to promote diversity and empower their citizens. France wants data to be available to others so they can make better models, promote diversity, and create fairer systems. France is also betting on their own talent. Canada differs in their approach, because they are trying to recruit foreign talent to promote AI innovation. The United Arab Emirates are significantly investing in AI and have a similar “betting on AI” approach that the United Kingdom has outlined. Lastly, Russia’s priority is to drive innovation so they can be a world AI superpower. The Kremlin will drive this growth.

Please view the figures below for an in-depth analysis between the 13 different countries and how they implement different design features in their AI policy strategy. A box with an “N/A” means that the given country does not address that design choice in their AI policy.

Country AI Policy						
	United States	China	Canada	European Union	United Kingdom	France
<b>Innovation</b>	Publicly funded R&D with private sector innovation with government oversight	Government and private sector driven, with many rules. Government controls growth	Government funded with regionalized approach to develop future AI workforce	High government regulations with "Sandbox" experimentation	Private sector and academia driven with government oversight	Focused on innovation in four sectors (Healthcare, Transportation, Defense, Environment)
<b>Government Funding</b>	Centralized funding. High government funding with no rules or expectations from private companies	High government funding and involvement. Local provinces drive growth	Regionalized funding to private companies and universities	Each individual European Country controls their funding. Funding sandboxes	Decentralized funding with government involvement	Government funding into many ministry departments. Very government centralized
<b>Law type</b>	Vertical (Industry specific)	Horizontal (Cross sectional)	Vertical (Industry specific)	Horizontal (Cross sectional)	Vertical (Industry specific)	Horizontal (Cross Sectional)
<b>Regulation Type (Inputs vs Outputs)</b>	Regulate outputs, oversee inputs	Regulate inputs and outputs	Regulate both inputs and outputs	Regulate inputs, oversee outputs	Oversee inputs and outputs	Regulate Inputs
<b>Punishment Type</b>	Guidance and oversight	Heavy fines	Guidance and oversight	Heavy fines	Guidance and oversight with international cooperation (ISO/IEC)	Government oversight (the EU punishes)
<b>Type of Stakeholder engagement</b>	Voluntary	Not voluntary	Voluntary	Not voluntary	Voluntary	Voluntary (The EU has existing frameworks)
<b>Military Innovation</b>	High government funding and R&D with use of small business innovation	Military-Civilian integration in the AI domain	N/A	Up to each individual country	Improving cyber defense systems	Focus on improving security and defense
<b>Foreign Policy</b>	Combat Chinese and Russian AI aggression. Continue to lead world in AI capabilities	Plan to lead the world in AI capabilities by 2030. Build-Up AI capabilities, no specific enemy stated	Attract global talent to Canada	Combat Chinese and Russian Aggression	Want to lead the world in AI capabilities and defend against malign use of AI	Improve AI capabilities to become one of the world leaders
<b>Privacy</b>	Priority	Concern	Priority	Top Priority	Priority	Top Priority
<b>Specificity of Terms and Laws</b>	Very specific	Vague	Specific	Very specific	Specific	Very Specific
<b>Process to make laws in government</b>	Slow and lengthy process. Many different methods to make laws	Very fast process. Ability to make laws within months	Slow process. Only one route	Slow and lengthy process. One established method to make laws	Slow and lengthy process. One established method to make laws	Lengthy slow process
<b>Government - Private Sector Trust</b>	Higher trust between government and private sector. Occasional anti-trust issues arise	Eroding between government and private sector	High Trust between government and private sector	Limited trust between government and private sector	High trust between government and private sector	Limited trust between government and businesses
<b>National Security/ Attracting Talent</b>	More concerns on national security, but does attract talent for universities, more lenient for students, no entrepreneurship visas, and shorter residency	More concerns on national security, but attracting talent at universities and large economy attracts workers.	Focusing on talent attraction, many options for citizenships in the STEM field, very open, and entrepreneurship visas	Country dependent	Concerned with attracting talent, more options for entrepreneurs and students, longer residency, and entrepreneurship visas	Focusing on talent attraction, accepts entrepreneurship visas, attracts students, very open policies
<b>Priority</b>	AI innovation with increased government support to innovate. Private- Public sector ethical innovation	Innovation driven by the PRC to become the leader of global AI innovation and to pass the U.S.	Recruit talent and keep talent	Consumer protection, data privacy, and AI ethics is the priority	Balancing innovation with ethical use of AI. Trying to emerge as an AI superpower	Diversity and citizen empowerment. Attracting foreign talent

Design Choice

Figure 21. AI policy design feature comparison between the United States, China, Canada, United Kingdom, and France.



		Country AI Policy						
		Netherlands	Russia	Japan	Australia	India	United Arab Emirates	Kenya
<b>Design Choice</b>	<b>Innovation</b>	Government stimulates start-ups, government drives innovation	Government driven growth	Three phase plan with government - industry - academia integration. Focus on start-ups as well	Technological specialization and research driven	Public Investment in specific sectors	Collaboration between public and private sector and driven by research	Small start-ups to address needs
	<b>Government Funding</b>	Government funding to different departments	High government funding	Government agencies to oversee and enhance AI	Government funding with road map	High government funding in specific areas	High government funding into research	Funding infrastructure
	<b>Law type</b>	Horizontal (Cross Sectorial)	Horizontal (Cross Sectorial)	Horizontal (Cross Sectorial)	Horizontal (Cross Sectorial)	Horizontal (Cross Sectorial)	Vertical (Industry specific)	Horizontal (Cross Sectorial)
	<b>Regulation Type (Inputs vs Outputs)</b>	Regulate Input	Regulate Output	Oversee both inputs and outputs	N/A	N/A	N/A	Regulate Distribution
	<b>Punishment Type</b>	Government oversight (The EU Punisher)	N/A	Guidance and oversight	N/A	Guidance and oversight	Guidance and Oversight	Heavy regulation for both
	<b>Type of Stakeholder engagement</b>	Voluntary (The EU has existing frameworks)	Not Voluntary	Participation highly encouraged, but voluntary	Voluntary	Voluntary	Voluntary	Not Voluntary
	<b>Military Innovation</b>	N/A	Driven by the Kremlin. Seek to be world leader in AI	N/A	N/A	N/A	Focus on cyber defense	N/A
	<b>Foreign Policy</b>	N/A	Emerges as leading country in AI	Became a world leader in AI	Exporting AI services	N/A	Emerges as AI superpower by 2031	N/A
	<b>Privacy</b>	Top Priority	Priority	Priority	Priority	Top Priority	Priority	Top Priority
	<b>Specificity of Terms and Laws</b>	Very Specific	Specific	Specific	Specific	Specific	Somewhat specific	N/A
	<b>Process to make laws in government</b>	Lengthy Slow process	Faster process. Putin implements "Decree"	Slow process. Only one route	Long Process	Longer Process	Lengthy Process	N/A
	<b>Government - Private Sector Trust</b>	Limited trust between government and business	Limited Trust between government and private sector	High trust between government, private sector, and academia	High trust between private sector and government	Low trust between government and private sector	Higher trust between government and private sector	Little to no trust
	<b>National Security/ Attracting Talent</b>	Focus on attracting talent	More difficult to get visas, less desirable to go after Ukraine War	Higher concerns on national security, more difficult to attract talent with stricter visa rules	Trying to attract talent, middle ground between the U.S. and Canada. Entrepreneur visas available, more difficult immigration pathway	Easier to get visas	Attracting talent to universities is a priority	Hard to attract talent
	<b>Priority</b>	Government driven growth and fairness	Government driven growth	AI Innovation with high academic involvement. Focus on domestic innovation	Specialization	Data privacy	Innovation and emerges as an AI superpower	Data sovereignty

Figure 22. AI policy design features for the Netherlands, Russia, Japan, Australia, India, United Arab Emirates, and Kenya.

# Chapter 5 – Generative AI and Foundation Models

“Until now, artificial intelligence could read and write, but could not understand the content. The new programs like ChatGPT will make many office jobs more efficient by helping to write invoices or letters. This will change our world.”<sup>512</sup>

- Bill Gates

## Introduction: Generative Artificial Intelligence

In 2023, the emergence of generative AI models has changed the landscape of artificial intelligence. Although generative AI isn't a completely new concept, newly released generative AI models such as GPT-4, ChatGPT, and Stable Diffusion have disrupted many markets and become a topic of priority for policymakers, investors, and technologists.<sup>513</sup> Generative AI is a large language model that uses deep learning to generate human like text and images.<sup>514</sup> Generative AI generates new text based on the input they receive (or the pretrained data), and uses transfer learning to process input text and generate outputs.<sup>515</sup> Transfer learning is an important process that is used in Generative AI models.

Transfer learning is the distillation of abstract knowledge from one learning domain or task and the reuse of that knowledge in a related domain or task.<sup>516</sup> It is a modification of experience or prior expectations about what types of categories are likely to exist in the world. Humans use transfer learning by drawing hypothesis and inferences by abstracting knowledge in one domain and reusing it in other domains.<sup>517</sup>

Transfer learning in machine learning is a technique where a model trained on one task is repurposed on a second related task. Machines can use transfer learning in the same way as humans use transfer learning in sports like table tennis and tennis.<sup>518</sup> Transfer learning only works in deep learning if a model features learned from the task are general and be applicable to many different domains.<sup>519</sup> For a more in-depth technical analysis on transfer learning, please refer to the appendix.

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<sup>512</sup> Timothy Nerozzi. “Bill Gates says ChatGPT will 'change the world,' make jobs more efficient”. *Fox Business*, 2023.

<sup>513</sup> Benjamin Larsen and Jayant Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. *World Economic Forum*, 2023.

<sup>514</sup> Larsen and Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. 2023.

<sup>515</sup> Larsen and Narayan, 2023.

<sup>516</sup> Kevin Canini, Mikhail Shashkov, and Thomas Griffiths. “Modeling Transfer Learning in Human Categorization with the Hierarchical Dirichlet Process”. *Princeton University*, 2020.

<sup>517</sup> Canini et al. “Modeling Transfer Learning in Human Categorization with the Hierarchical Dirichlet Process”. 2020

<sup>518</sup> Jason Brownlee. “A Gentle Introduction to Transfer Learning for Deep Learning”. *Machine Learning Mastery*, 2017.

<sup>519</sup> Brownlee. “A Gentle Introduction to Transfer Learning for Deep Learning”. 2022.



Generative AI has incredible capabilities that have not been seen before in the field of Artificial Intelligence. Generative AI models have new architectures of search engines, can explain complex algorithms, create personalized therapy bots help build apps from scratch, explain scientific concepts, writing cooking recipes, and complete college essays.<sup>520</sup> Generative AI can also create text-to-image programs through models like DALL-E, Stable, Diffusion, and Midjourney.<sup>521</sup> Bill Cusick, the creative director at Stability AI (developer of Stable Diffusion) believes that models like Stable Diffusion are creating software that is “the foundation for the future of creativity”.<sup>522</sup>

Although generative AI has many incredible new capabilities and benefits, there are clear risks and potential problems with these models. Models like ChatGPT are likely to reinforce existing predispositions towards reliance on automated systems reducing the human element.<sup>523</sup> These models also reinforce the bias towards specific groups of people and content that exist on the internet. In addition, models like ChatGPT lack citations in their output, which makes it difficult to fact check the systems output.<sup>524</sup>

Generative AI has been a controversial topic in 2023 and is now taking many headlines in the news. It is important to note that generative AI is not a new technology and the machine learning techniques to develop these models have significantly evolved over the past decade. Generative AI models will continue to roll out into society. At the time of writing this, GPT-4 has also been released, and companies like OpenAI will continue to release generative AI models at a fast pace.

## Foundation Models and Generative AI

Foundation models serve as a strong basis for creating generative AI models due to their ability to handle large amounts of data.<sup>525</sup> For example, if the objective is to develop a generative AI model for art, a pre-trained foundational model would first be trained on a vast collection of images. After the training, the model could then produce novel images to produce artwork.<sup>526</sup> This is how generative AI models like Dalle-E function.

A foundation model is any model that is trained on broad data (generally using self-supervision at scale) that can be adapted to a wide range of downstream tasks.<sup>527</sup> Some current examples of foundation models include ChatGPT, DALLE, Stability Diffusion, GPT-3, The Wu Dao 2.0,

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<sup>520</sup> Benjamin Larsen and Jayant Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. *World Economic Forum*, 2023.

<sup>521</sup> Larsen and Narayan. “Generative AI: a game-changer that society and industry need to be ready for”. 2023.

<sup>522</sup> Larsen and Narayan, 2023.

<sup>523</sup> Henry Kissinger, Eric Schmidt and Daniel Huttenlocher. “ChatGPT Heralds an Intellectual Revolution”. *The Wall Street Journal*, 2023.

<sup>524</sup> Kissinger et al, 2023.

<sup>525</sup> Paul Smith-Goodson. “IBM Demonstrates Groundbreaking Artificial Intelligence Research Using Foundational Models And Generative AI”. *Forbes*, 2023.

<sup>526</sup> Smith-Goodson, 2023.

<sup>527</sup> Rishi Bommasani. “On the Opportunities and Risks of Foundation Models”. *Center for Research on Foundation Models (CRFM) - Stanford Institute for Human-Centered Artificial Intelligence (HAI) Stanford University*, 2021.

ChatGPT, BERT, and PaLM. Foundation models are now using these applications and applying them to society on a scale that has never been seen before.

It is important to note that not all foundation models are generative AI models. It is possible that a non-generative AI model, like natural language understanding models (NLUs), can be used as a foundation model. NLUs are a subset of natural language processing models which includes tasks like sentiment analysis, text entailment, and machine translation.<sup>528</sup> Some of NLUs sub-tasks like text classification can be used in foundation models; however, are not generative AI. Most people use the terms generative AI and foundation models interchangeably; however, there are instances where foundation models use non-generative AI like NLUs.

Over the past five years, artificial intelligence has evolved rapidly due to the emergence and development of deep learning. Deep learning has significantly increased the capabilities of artificial intelligence in the field of Natural Language Processing (NLP) and computer vision.<sup>529</sup> Sophisticated NLP and computer vision models can be used on a wide range of applications such as text recognition, translation, and generations, and facial recognition.<sup>530</sup> Now, these sophisticated NLP and computer vision models have transformed into models called foundation models (a generative AI application), which are trained on billions of parameters and produce outputs that are incredibly accurate and produce intelligence that has not been seen before in other AI systems.

Before the introduction of foundation models, companies and researchers used recurrent neural networks (RNNs) to generate NLP.<sup>531</sup> However, these models had limitations in computing power and ability to scale. Now, foundation models are using incredible amounts of computing power and using billions of parameters in their models. Foundation models are pretrained models that used enormous amounts of data to make downstream applications in the fields of NLP and computer vision.<sup>532</sup> These models are using transfer learning to open up capabilities in the field of artificial intelligence that have never been seen before.

Aside from defining these models as foundation models or generative AI, Europe has adopted a new term for these models, calling them General Purpose Artificial Intelligence Systems (GPAIS).<sup>533</sup> Europe has defined these models as GPAIS in their development of the new European AI Act. The Slovenian EU presidency has defined GPAIS as an “AI system... able to perform generally applicable functions such as image/speech recognition, audio/video

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<sup>528</sup> Rahul Samant, Mrinal Bachute, Shilpa Gite, and Ketan Kotecha. “Framework for Deep Learning-Based Language Models Using Multi-Task Learning in Natural Language Understanding: A Systematic Literature Review and Future Directions”. *Symbiosis Institute of Technology*, 2022.

<sup>529</sup> Dieuwertje Luitse and Wiebke Denkena. “The great Transformer: Examining the role of large language models in the political economy of AI”. *Sage Journals*, 2021.

<sup>530</sup> Luitse and Denkena. “The great Transformer: Examining the role of large language models in the political economy of AI”. 2021.

<sup>531</sup> David Rumelhart, Geoffrey Hinton, and Ronald Williams. “Learning representations by back-propagating errors”. *Nature*, 1986.

<sup>532</sup> Luitse and Denkena. “The great Transformer: Examining the role of large language models in the political economy of AI”. 2021.

<sup>533</sup> Carlos Gutierrez Anthony Aquirre; Risto Uuk, Claire Boine Matija Franklin. “A Proposal for a Definition of General-Purpose Artificial Intelligence Systems”. *Future of Life Institute*, 2022.

generation, pattern detection, question answering, translation, etc.”.<sup>534</sup> The French EU presidency states that GPAIS can be used in a plurality of contexts and be integrated in a plurality of other AI systems.<sup>535</sup>

Although these European nations have different definitions of GPAIS, some illustrate GPAIS as “In fixed-purpose AI systems we choose a set of tasks, then train a system to do those particular tasks. In a GPAIS, we train the system, then choose tasks for it to do” (Gutierrez et al 2022). It is important to note that defining these systems is complex and can be country dependent. This is why it is very hard to draft legislation to regulate foundation models/GPAIS; these systems are hard to define, and policy makers have a hard time grasping exactly what these models are and how they impact society.

Countries from around the world are significantly investing in foundation models and generative AI as they are clearly showing their ability to highly perform in areas such as finance, healthcare, military, education, transportation, and many other sectors. Organizations such as Google, Huawei, OpenAI, and The Beijing Academy of Artificial Intelligence are investing billions of dollars into developing foundation models for future use.<sup>536</sup>

The United States and China are heavily investing into generative AI and foundation models because they likely will hold the key to having the upper hand in terms of military and economic power.<sup>537</sup> It seems that several first world countries are in a competition to develop the most advanced artificial intelligence systems. For the most part, the United States and China are leading the innovation in the field of artificial intelligence, and development of generative AI hold a key in deciding who will have the upper hand in the decades to come. The United States understands the importance of generative AI and needs to continue to innovate in this field to ensure military and economic security. In addition, the U.S. needs to employ these models ethically and not negatively affect citizens.

## Foundation Models

### Technical Overview

A foundation model is any model that is trained on broad data that can be adapted to a wide range of downstream tasks. Foundation models use transfer learning, which takes knowledge learned from one task and is able to apply it to another task. Transfer learning is what makes foundation models possible; however, it is the scale of these models that make them so powerful.<sup>538</sup> It is important to note that not all known transformer models are foundation models. However, all foundation models use transfer learning and employ a two-step AI deployment like transformer models. Most foundation models are also generative AI; however, it is possible for some foundation models to use non-generative AI like NLUs. The image below shows a high-

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<sup>534</sup> Carlos Gutierrez et al. “A Proposal for a Definition of General-Purpose Artificial Intelligence Systems”. *SSRN*, 2022.

<sup>535</sup> Gutierrez et al. “A Proposal for a Definition of General-Purpose Artificial Intelligence Systems”. 2022.

<sup>536</sup> Rob Toews. “10 AI Predictions For 2022”. *Forbes*, 2021.

<sup>537</sup> Nathan Benaich and Ian Hogarth. “State of AI Report 2022”. *State of AI*, 2022.

<sup>538</sup> Rishi Bommasani. “On the Opportunities and Risks of Foundation Models”. *Center for Research on Foundation Models (CRFM) - Stanford Institute for Human-Centered Artificial Intelligence (HAI) Stanford University*, 2021.

level overview of how foundation models are trained and deployed. The rest of this chapter and the appendix goes more into depth on many of these tasks, and how models use foundation models and generative AI.

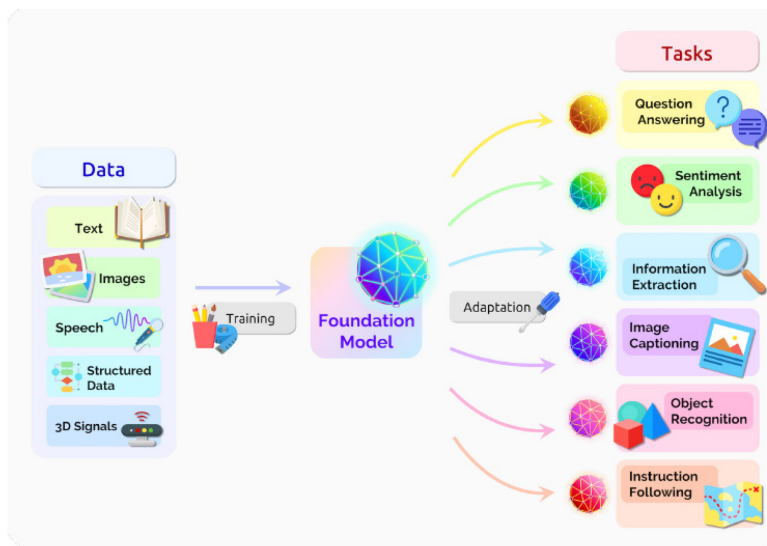


Figure 23. Visual depiction of foundation models.<sup>539</sup>

### The Recent Evolution of Artificial Intelligence – Generative AI

Large-scale generative AI models are achieving great successes and changing the field of Artificial Intelligence. These models have billions of parameters that are allowing them to make significant advances in NLP, computer vision, and other fields. Generative AI is powerful and can significantly elevate a company's or even country's capabilities in AI.<sup>540</sup>

United States companies have developed pretrained models such as Open AI's GPT-4, ChatGPT, GPT-3 and DaLL-E, Google's BERT and PaLM, and Meta's OPT. Chinese companies have developed pretrained models such as The Beijing Academy of Artificial Intelligence's Wu Dao 2.0 and Huawei's PanGu Alpha.<sup>541</sup> The United States and China are leading the development of foundation models and they are competing to develop the best models.<sup>542</sup> The country who emerges with the large-scale pretrained model with the most capabilities will have the upper hand in business and military applications.<sup>543</sup>

<sup>539</sup> Bommasani. "On the Opportunities and Risks of Foundation Models". 2021.

<sup>540</sup> Benjamin Larsen and Jayant Narayan. "Generative AI: a game-changer that society and industry need to be ready for". *World Economic Forum*, 2023.

<sup>541</sup> Aaron Snoswell and Dan Hunter. "Robots are creating images and telling jokes. 5 things to know about foundation models and the next generation of AI". *The conversation*, 2022.

<sup>542</sup> Craig Smith. "U.S. vs. China Rivalry Boosts Tech—and Tensions Militarized AI threatens a new arms race". *IEEE Spectrum*, 2021.

<sup>543</sup> Smith. "U.S. vs. China Rivalry Boosts Tech—and Tensions Militarized AI threatens a new arms race". 2021.

## American Foundation Models

### GPT-4 – Open AI

At the time of completing this Thesis, OpenAI released GPT-4 on March 14<sup>th</sup>, 2023.<sup>544</sup> OpenAI has claimed that GPT-4 is much bigger and better than ChatGPT. GPT-4 is a multimodal large language model, which means that it can respond to both text and images, a capability that ChatGPT could not do.<sup>545</sup> GPT-4 will only be available to users who sign up to the GPT-4 waitlist and for paid ChatGPT subscribers. OpenAI is making its full transition from a Nonprofit research lab to a for profit tech firm.<sup>546</sup>

Oren Etzioni at the Allen Institute for AI says that GPT-4 has incredible capabilities and that, “GPT-4 is now the standard by which all foundation models will be evaluated”.<sup>547</sup> For example, if you give GPT-4 a photo of contents and food in your fridge, GPT-4 will be able to come up with recipes that use the pictured ingredients.<sup>548</sup>

OpenAI says GPT-4 has significantly improved from ChatGPT as GPT-4 has passed a number of tests and benchmarks including the Uniform Bar Exam, LSAT, SAT math, and SAT Evidence based reading exams.<sup>549</sup> GPT-4 scored in the 88<sup>th</sup> percentile and above on these mentioned exams. These capabilities are remarkable and will change society and how people operate. Open AI stresses that GPT-4 has gone through six months of safety training, and that it is “82 percent less likely to respond to requests for disallowed content and 40 percent more likely to produce factual responses than GPT-3.5.”<sup>550</sup>

Although there are many incredible capabilities with GPT-4, it is too early to tell the associated risks. Once GPT-4 becomes more mainstream, its system and outputs will be tested more, and the risks and downfalls will become more apparent. OpenAI has taken the lead role in developing foundation models in late 2022 and early 2023. Although the financial system in March of 2023 has had a rocky path with the collapse of Silicon Valley Bank, OpenAI seems to be innovating and releasing highly capable models that have not been seen before.

### ChatGPT - OpenAI

Before GPT-4, OpenAI released ChatGPT, which was a monumental moment for foundation models as it showed the world the capabilities and applications foundation models can have. ChatGPT was released in November of 2022 for the general public to use. Some have claimed that ChatGPT is the best artificial intelligence chatbot ever released to the general public.<sup>551</sup> ChatGPT has evolved from GPT-3 because it shows more human like qualities with opinions that can at times be indistinguishable from humans.<sup>552</sup> ChatGPT also will screen out hate speech

<sup>544</sup> Will Heaven. “GPT-4 is bigger and better than ChatGPT—but OpenAI won’t say why”. *MIT Technology Review*, 2023.

<sup>545</sup> Heaven, “GPT-4 is bigger and better than ChatGPT—but OpenAI won’t say why”. 2023.

<sup>546</sup> Heaven, 2023.

<sup>547</sup> Ibid.

<sup>548</sup> Ibid.

<sup>549</sup> James Vincent. “OpenAI announces GPT-4 — the next generation of its AI language model”. *The Verge*, 2023.

<sup>550</sup> Vincent. “OpenAI announces GPT-4 — the next generation of its AI language model”. 2023.

<sup>551</sup> Kevin Roose. “The Brilliance and Weirdness of ChatGPT”. *The New York Times*, 2022

<sup>552</sup> Roose. “The Brilliance and Weirdness of ChatGPT”. 2022.

in prompts and will refuse to reply to “inappropriate requests”.<sup>553</sup> The potential for ChatGPT is incredible as people can now write essays, spark new ideas, and even build parts of websites from ChatGPT.

ChatGPT is further specialized beyond a basic large language model and uses feedback from humans to improve the model so that it can generate more conversational as time progresses.<sup>554</sup> ChatGPT has evolved into a model that can produce text at a speed that humans cannot comprehend. In a matter of seconds, ChatGPT can produce answers from a prompt that is coherent and can explain topics at a high level.<sup>555</sup> ChatGPT simply does not copy and paste an entire article from the web on a topic, it produces a comprehensive answer that is at times better than a human’s response.

Although ChatGPT is an incredible generative AI model, it does have some drawbacks. One drawback of ChatGPT is that the information it produces in its answers to prompts, are not always correct.<sup>556</sup> ChatGPT has the ability to answer most open book questions, like Siri; however, some answers (especially to recent events) can be blatantly false.<sup>557</sup> For example, Fiona Fang (author at the Economics Review at NYU) asked ChatGPT who won the World Cup in 2022, and ChatGPT responded and said that the information hasn’t been released yet. Fang prompted ChatGPT after the World Cup concluded. Some of ChatGPT’s knowledge is limited after 2021; however, the model is continuing to improve and is becoming more accurate.<sup>558</sup>

Please view the appendix to see how ChatGPT has helped me in my own personal business.

It is important to note that this paper was published in April of 2023. OpenAI and other tech companies will continue to develop new generative AI models that have major impacts on society. ChatGPT has had a significant impact on social media, academia, industry, and policy. The world has never seen a model like ChatGPT. I am sure within the next few years that more generative AI models will roll out and surpass the capabilities of ChatGPT.

### Open Pretrained Transformer (OPT) – Meta

In January of 2022, Meta released its newest foundation model, called the Open Pretrained Transformer. OPT has 175 billion parameters and is the same size as Open AI’s GPT-3.<sup>559</sup> A team of university researchers in the United States has built this model as opposed to the private sector approach used by Open AI and Google.<sup>560</sup> Joel Pineau, a researcher, and professor at McGill University stated, “We know the gap that exists between universities and industry in terms of the ability to build these models. Making this one available to researchers was a no-

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<sup>553</sup> Roose, 2022

<sup>554</sup> Henry Kissinger, Eric Schmidt and Daniel Huttenlocher. “ChatGPT Heralds an Intellectual Revolution”. *The Wall Street Journal*, 2023.

<sup>555</sup> Kissinger and Schmidt. “ChatGPT Heralds an Intellectual Revolution”. 2023.

<sup>556</sup> Fionna Fang. “Exploring the Capabilities and Challenges of ChatGPT”. *The Economics Review at New York University*, 2023. “Exploring the Capabilities and Challenges of ChatGPT”. 2023.

<sup>557</sup> Fang. “

<sup>558</sup> Fang, 2023.

<sup>559</sup> Will Heaven. “Meta has built a massive new language AI—and it’s giving it away for free”. *MIT Technology Review*, 2022.

<sup>560</sup> Heaven. “Meta has built a massive new language AI—and it’s giving it away for free”. 2022.

brainer”.<sup>561</sup> OPT has the capability to generate creative text, solve basic math problems, answer reading comprehension questions and much more. Joel Pineau stated in April of 2022, “What we call state-of-the-art nowadays can’t just be about performance,” she says. “It has to be state-of-the-art in terms of responsibility as well.”<sup>562</sup> Meta will continue to innovate its OPT model as it has a significant amount of data to use from Facebook and Instagram to train it.

### DALL-E - OpenAI

Open AI’s DALL-E 2 is a new AI system that can create realistic images and art from a description in natural language.<sup>563</sup> It can create original, realistic images from text descriptions. In January of 2021, OpenAI introduced DALL-E, and one year later it introduced DALL-E 2 in 2022. In 2021, the OpenAI consortium, founded by Elon Musk, and financially backed by Microsoft unveiled the DALL-E AI pretrained model.<sup>564</sup>

DALL-E 1 used billions of parameters and compressed images into a series of words and the system learned what image to predict next. DALLE-2 uses a model called Contrastive Language-Image Pre-training (CLIP) to link textual semantics and visual representations.<sup>565</sup> CLIP is trained on hundreds of millions of images and their associated captions, and the model learns how much a given text snippet relates to an image. (Reference the appendix to see examples of DALL-E’s capabilities)

### Midjourney – Leap Motion

In April of 2022, David Holz and his company, Leap Motion released an AI application that can generate realistic images from text prompts.<sup>566</sup> Leap Motion is a San Francisco based company that is rivaling OpenAI’s DALL – E and has abilities to generate artwork through AI with specific emphasis on the painterly aesthetics in the images it produces.<sup>567</sup>

Midjourney has differentiated itself from Stable Diffusion and DALL -E because of its ability to be proficient in adapting art styles that can be mixed and matched to create an image.<sup>568</sup>

Midjourney is an AI image generation tool that takes inputs through text prompts and parameters and uses a Machine Learning algorithm trained on large amounts of data to generate unique and artistic pictures.<sup>569</sup> Midjourney uses its Discord bot to send as well as receive calls to AI servers and almost everything happens on Discord.<sup>570</sup> Midjourney is differentiating itself in the market

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<sup>561</sup> Ferguson, T. “Meta Has Created a New Language AI That is for Free”. *Medium*, 2022.

<sup>562</sup> Heaven, 2022.

<sup>563</sup> Andrew Tarantola. “OpenAI’s DALL-E 2 produces fantastical images of most anything you can imagine”. *Engadget*, 2022.

<sup>564</sup> Tarantola. “OpenAI’s DALL-E 2 produces fantastical images of most anything you can imagine”. 2022.

<sup>565</sup> Ryan O’Connor. “How DALL-E 2 Actually Works”. *AssemblyAI*, 2022.

<sup>566</sup> Rob Ralkowitz. “Midjourney Founder David Holz on The Impact Of AI On Art, Imagination And The Creative Economy”. *Forbes*, 2022.

<sup>567</sup> Rob Ralkowitz. “Midjourney Founder David Holz on The Impact Of AI On Art, Imagination And The Creative Economy”. 2022.

<sup>568</sup> Arham Islam. “How Do DALL-E 2, Stable Diffusion, and Midjourney Work?”. *MarketTechPost*, 2022.

<sup>569</sup> Islam. “How Do DALL-E 2, Stable Diffusion, and Midjourney Work?” 2022.

<sup>570</sup> Islam, 2022.



and is able to create artistic images with unique styles that has never been seen before from an AI model.

### GPT-3 - OpenAI

GPT-3 (Generative Pre-trained Transformer) is a third-generation, autoregressive language model that uses deep learning to produce human-like text.<sup>571</sup> It is a computational system designed to generate sequences of words, code, or other data, starting from a source input, called the prompt. The language model is trained on an unlabeled dataset that is made up of texts, such as Wikipedia and many other sites, primarily in English, but also in other languages.

These statistical models need to be trained with large amounts of data to produce relevant results.<sup>572</sup> GPT-3 uses 1.75 billion parameters and is trained on Microsoft's Azure's AI supercomputer. Only companies with extraordinary computational power can produce foundation models like GPT-3. GPT-3 takes an input in the same way Google takes an input of someone entering text into the search bar. GPT-3 produces the text that is a statistically good fit, given the starting text, without supervision, input or training concerning the "right" or "correct" or "true" text that should follow the prompt.<sup>573</sup> Please refer to the appendix for personal examples of how I used GPT-3 to generate text. Anyone can use GPT-3 and use it to generate interesting language.

### BERT – Google

The Bidirectional Encoder Representations from Transformer model (BERT) was developed by Google's AI Language. BERT is designed to pretrain deep bidirectional representations from unlabeled text by jointly conditioning on both left and right context in all layers. BERT is pre-trained on two unsupervised tasks—masked language modeling and next sentence prediction, thus making it an effective technique for sentiment classification.<sup>574</sup> BERT is currently applicable in 70 different languages.

Before GPT-3, BERT was the leading foundation model in the world. The model is pre-trained on 2,500 million internet words and 800 million words of Book Corpus.<sup>575</sup> In a Stanford QA dataset, BERT achieved a General Language Understanding Evaluation (GLUE) score of 80.4% and a 93.3% accuracy on SQuAD dataset.<sup>576</sup> However, GPT-3 and now ChatGPT have greater capabilities than BERT.

As of 2020, GPT-3 is trained on 175 billion parameters, and is 470 times bigger in size than BERT.<sup>577</sup> BERT is trained on latent relationship challenges between the text of different contexts, GPT-3 training approach is relatively simple compared to BERT. Therefore, GPT-3 can be a preferred choice at tasks where sufficient data isn't available, with a broader range of

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<sup>571</sup> Massimo Chiriatti and Luciano Floridi. "GPT-3: Its Nature, Scope, Limits, and Consequences"; *Minds and Machines* (2020) 30:681-694. *SpringerLink*, 2020.

<sup>572</sup> Chiriatti and Floridi. "GPT-3: Its Nature, Scope, Limits, and Consequences". 2020.

<sup>573</sup> Chiriatti and Floridi, 2020.

<sup>574</sup> James Briggs. "Masked-Language Modeling With BERT". *Towards Data Science*, 2021.

<sup>575</sup> Sejuti Das. "GPT-3 Vs BERT For NLP Tasks". *AIM*, 2020.

<sup>576</sup> Das. "GPT-3 Vs BERT For NLP Tasks". 2020.

<sup>577</sup> Das, 2020.



application.<sup>578</sup> ChatGPT has also shown incredible power and capabilities. OpenAI is expected to come out with an GPT-4 in the year 2023 with even more capabilities than both ChatGPT and GPT-3.<sup>579</sup>

### PaLM – Google

In October of 2021, Google developed PaLM (Pathways Language Model), which has scaled to 540 billion parameters.<sup>580</sup> PaLM has shown increased capabilities in language understanding and generation, reasoning, and code related tasks.<sup>581</sup>

In April of 2022, Google researchers have determined that PaLM has surpassed the performance of prior large models, such as Megatron-Turing NLG, Gopher, Chinchilla, and LaMDA, on 28 of 29 of tasks that span question-answering tasks, cloze and sentence-completion tasks, Winograd-style tasks, in-context reading comprehension tasks, common-sense reasoning tasks, SuperGLUE tasks, and natural language inference tasks.<sup>582</sup> (Please refer to the appendix to see some of PaLM’s Capabilities)

## Chinese Transformer Models

### Wu Dao 2.0 – Beijing Academy of Artificial Intelligence

The Beijing Academy of Artificial Intelligence (BAAI) is a non-profit organization out of Beijing that has developed a foundation model called the Wu Dao 2.0 that rivals the capabilities of GPT-3 and ChatGPT. The Chinese model has been trained on 1.75 trillion parameters, which is ten times greater than the training set of GPT-3.<sup>583</sup> The Wu Dao 2.0 (which translates to understanding the laws of nature), can write poems, answer questions, write essays and write text images like GPT-3.<sup>584</sup>

The Wu Dao 2.0 can learn from text and images and can evaluate tasks that deal with both – something that GPT-3 cannot do.<sup>585</sup> In *Engadget*, Andrew Tarantola explains that Wu Dao 2.0 generates both alt text based off a static image and generate nearly photorealistic images based on natural language descriptions.<sup>586</sup> It can also predict the 3D structures of proteins, like DeepMind’s AlphaFold.<sup>587</sup>

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<sup>578</sup> Ibid.

<sup>579</sup> Alberto Romero. “GPT-4 Is Coming Soon. Here’s What We Know About It”. *Towards Data Science*, 2022

<sup>580</sup> Sharan Narang and Aakansha Chowdhery. “Pathways Language Model (PaLM): Scaling to 540 billion Parameters for Breakthrough Performance”. *Google AI Blog*, 2022.

<sup>581</sup> Narang and Chowdhery. “Pathways Language Model (PaLM): Scaling to 540 billion Parameters for Breakthrough Performance”. 2022.

<sup>582</sup> Narang and Chowdhery, 2022

<sup>583</sup> Alex Zhavoronkov. “Wu Dao 2.0 - Bigger, Stronger, Faster AI From China”. *Forbes*, 2021.

<sup>584</sup> Zhavoronkov. “Wu Dao 2.0 - Bigger, Stronger, Faster AI From China”. 2021.

<sup>585</sup> Alberto Romero. “GPT-3 Scared You? Meet Wu Dao 2.0: A Monster of 1.75 trillion Parameters”. *Towards Data Science*, 2021.

<sup>586</sup> Andrew Tarantola. “China’s gigantic multi-modal AI is no one-trick pony”. *Engadget*, 2021.

<sup>587</sup> Alberto Romero. “GPT-3 Scared You? Meet Wu Dao 2.0: A Monster of 1.75 trillion Parameters”. *Towards Data Science*, 2021.

The chairman of BAAI, Zhang Hangjiang stated, “What we are building is a power plant for the future of AI, with mega data, mega computing power, and mega models, we can transform data to fuel the AI applications of the future”.<sup>588</sup> The Wu Dao 2.0 has incredible capabilities in NLP, text recognition, image recognition, facial recognition, and image generation. The Wu Dao 2.0 has by far more data points than GPT-3; however, it is unclear which transformer model has more capabilities.

### PanGu Alpha - Huawei

After Open AI launched the GPT-3 transformer model, Chinese companies started to look for options to develop language transformer models. The Chinese firm, Huawei created a pretrained language modeled (PLM) called PanGu Alpha. PanGu Alpha is trained on 1.1 TB of Chinese news, websites, languages, e-books, social media platforms, and encyclopedias (Goled, 2021).

Huawei wanted to offer a foundation model that was more powerful and adaptive than Open AI’s GPT-3 and that specializes in Mandarin and Cantonese. It does not address the bias that GPT-3 has and does not respond to questions without paraphrasing training data.<sup>589</sup> The capabilities of PanGu Alpha are still evolving. It is not as powerful as the Wu Dao transformer model; however, it does have a lot of data points and is a more powerful model than GPT-3 in the Chinese language. PanGu Alpha is still new to the market and cannot match many of GPT-3’s capabilities.

### European Foundation Models

#### Stable Diffusion – Stability AI

Stable Diffusion is a machine learning model that converts text into realistic images.<sup>590</sup> Stability AI, Runway, and LMU Munich’s CompVis group launched Stable Diffusion in late 2022.<sup>591</sup> Stability AI is located in London, England, Runway is an American company, and LMU Munich’s CompVis group is located in Germany. Stability AI has been used in many social media posts as of late on platforms like TikTok and Instagram, as they are gaining popularity due to the realistic nature of these images.<sup>592</sup>

Stable diffusion can essentially generate images from scratch and can appear to be very realistic. There are many capabilities with Stable Diffusion for artists and social media influencers; however, many issues arise when it comes to deepfakes on social media. Stable Diffusion is having an impact on many industries and will continue to evolve in the future.

### U.S. Strategic Importance

Foundation models are going to be a key player in the economic, political, geopolitical, and academic sectors and have significant impacts on U.S. military readiness and national security. Specifically, foundation models will affect the United States’ relationship with China in these six sectors. The United States needs to prioritize the development of ethical high-performing

<sup>588</sup> Andrew Tarantola. “China’s gigantic multi-modal AI is no one-trick pony”. *Engadget*, 2021.

<sup>589</sup> Shraddha Goled. “GPT-3’s Cheap Chinese Cousin”. *Aim*, 2021.

<sup>590</sup> Yasmine Leung. “What is Stable Diffusion AI, and How Does the Image Generator Work?”. *HITC*, 2023.

<sup>591</sup> Leung. “What is Stable Diffusion AI, and How Does the Image Generator Work?”. 2023.

<sup>592</sup> Leung, 2023.

foundation models to enhance our and our ally's military readiness and national security and assist the U.S.'s ability to leverage political and geopolitical power. There currently is no other country in the world other than China that can compete with the United States in foundation model capabilities, and the United States owes it to its citizens and allies around the world to maintain the upper hand to ensure peace and good diplomacy.

Since 2017, 73 percent of foundation models have been developed in the United States, and 15% have been developed in China.<sup>593</sup> In the United States, major Technology companies like Microsoft have supported and funded many of the emerging AI companies like OpenAI to facilitate these foundation models.<sup>594</sup> However, it will be interesting to see how the United States responds to the collapse of Silicon Valley Bank. Many of the emerging startups in the AI space are backed by SVB. The government's response for the rest of 2023 will be very telling for the future of foundation models because of the United States does not fund many of these companies back, investors will grow weary of future companies and innovation could stall.

The United States should be concerned with the Chinese development of pretrained AI models, and with China's progression in the field of Artificial Intelligence. China's WuDao 2.0 model has surpassed Open AI's GPT-3 in terms of both funding and parameters.<sup>595</sup> It already has 22 partners, including smartphone maker Xiaomi, on-demand delivery service provider Meituan, and short-video giant Kuaishou.<sup>596</sup> Although the WuDao 2.0 model has not surpassed the GPT-3 model's capabilities, the Chinese are quickly closing the gap.

## Economic Impact

Foundation models have major implications in the global economy. Just as Google runs the playing field for search engines, the Chinese Wu Dao 2.0 could grow to monopolize the language modeling world.<sup>597</sup> The U.S. government and U.S. companies want the world to use American foundation models, not Chinese models. The United States needs to promote private sector models and create more funding opportunities for both the private and public sector and academia with the aim of creating foundation models that perform at a higher levels than the Chinese foundation models.

One concern with the emergence of foundation models, is that companies around the United States are not using their own AI systems. Major companies in fields of banking and healthcare are relying on AI models from other companies.<sup>598</sup> The same is happening for foundation models; however, there are only a few companies (like Google, OpenAI, Baidu, etc) that can develop these models. Many companies are outsourcing their AI systems to a few number of

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<sup>593</sup> Dennis Hillemann. "Unlocking the Power of AI Foundation Models: Insights from the LEAM.AI Conference". FieldFisher, 2023.

<sup>594</sup> Hilleman. "Unlocking the Power of AI Foundation Models: Insights from the LEAM.AI Conference". 2023.

<sup>595</sup> Coco Feng. "US-China tech war: Beijing-funded AI researchers surpass Google and OpenAI with new language processing model". *South China Morning Post*, 2021.

<sup>596</sup> Feng. "US-China tech war: Beijing-funded AI researchers surpass Google and OpenAI with new language processing model". *South China Morning Post*, 2021.

<sup>597</sup> Azamat Abdoullaev. "Wu Dao 2.0: Why China is Leading the Artificial Intelligence Race?". BBN Times, 2021.

<sup>598</sup> Alex Edich, Greg Phalin, Rahil Jogani, Sanjay Kaniyar. "Driving Impact at Scale from Automation and AI". *McKinsey*, 2019.

companies because they cannot develop these models by themselves. There is a lot of risk with entire industries relying on a few companies to develop their AI systems. The potential for data misalignment, ever-increasing scale, and security risks increases because there are not many companies that can challenge them, and the diversity of talent and knowledge is so concentrated.<sup>599</sup>

As a result of companies outsourcing the AI systems, the AI supply chain has manifested into a business to business to customer (B to B to C) supply chain. Foundation models are transforming how businesses operate and are forcing many large companies to outsource AI. The consumer is now reliant on a select few companies that develop these foundation models because major industry leading companies in all fields are starting to rely on these models. There are opportunities for major advances in fields and opportunities to help consumers more than before. There are also opportunities for the consumer to be put at a disadvantage through bias and manipulation from the upstream developers of foundation models.

Google and OpenAI are allowing for flexible and scalable deployment of these foundation models, and they are making it attractive for companies that do not have the financial resources to operate at their own computational power.<sup>600</sup> One of the greatest challenges that foundation models face is scalability, and if the United States can scale foundation models better than the Chinese, then the U.S. will have an economic advantage. The U.S. government would much rather have American companies outsource their foundation model AI system to other American technology companies as opposed to Chinese technology companies. Therefore, the U.S. government should help create an environment that facilitates scalability, research, and ethical deployment of American foundation models in the private sector.

Kevin Scott, Microsoft's Chief Technology Officer claims that more than 80% of the AI research at Microsoft is now focused on AI foundation model.<sup>601</sup> Companies around the world are starting to pour massive investments and research on foundation models into their business strategy. The United States currently has more companies and investments in foundation models; however, China is quickly closing the gap and increasing their capabilities. The United States will most likely get caught by China if the two countries remain on the same path. As of May 2022, Analytics India Magazine has listed all the tech companies who have successfully built a foundation model.

As of late 2022, China currently has three companies that have developed foundation models (Baidu's ERNIE 3.0 Titan (2021), Huawei's PanGu Alpha (2021), and Beijing Academy of Artificial Intelligence's Wu Dao 2.0 (2021). Additionally, the Israeli company, AI21's Jurassic-1 foundation model is emerging as a scalable foundation model.<sup>602</sup> At the time of this work, other models have gained attention, such as Google's LaMDA, and Hugging Face's new model. Other

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<sup>599</sup> Elliot Turner. "How to Use Massive AI Models (Like GPT-3) in Your Startup". *Future*, 2022.

<sup>600</sup>Dieuwertje Luitse and Wiebke Denkena. "The great Transformer: Examining the role of large language models in the political economy of AI". *Sage Journals*, 2021.

<sup>601</sup> "The World that BERT Built - Huge "foundation models" are turbo-charging AI progress" *The Economist*, 2022

<sup>602</sup> Avi Gopani. "Large tech firms and the language models they associate with". 2022.

countries are realizing the importance of these models as well and are attempting to create foundation models of their own.

From an economic standpoint, the United States needs to continue to innovate foundation models to bring revenue to the United States rather than away from the U.S. to China. Google, Microsoft, Meta, and other American tech companies saw Chinese firms in their rear-view mirror in 2015. By 2018, China filed 2.5 more patents in AI technologies than the United States.<sup>603</sup> As of late, the private sector has been the key for foundation model and other AI innovation. In contrast to the nuclear weapons arms race in the cold war, the private sector is dictating the innovation, not the government. Although Beijing is much more involved in AI development than Washington D.C., it has mostly been private sector driven innovation in the United States.<sup>604</sup>

The private sector is clearly leading the innovation and growth of foundation models, and the United States needs to ensure that the private sector is innovating in an ethical way in this field. The good news for the United States is that the U.S. is leading China in terms of AI startup funding. The graph below depicts the number of AI Unicorns (AI companies who have a valuation of \$1 billion or more), and their respective funding from companies around the world.

### Investing in AI: 182 active AI unicorns totaling \$1.3T of combined enterprise value

► The US outperforms other countries in the number of AI unicorns, followed by China, UK & Israel. US unicorns have reached a combined market value of over €800 billion.

	Number of AI unicorns	Total funding raised	Combined enterprise value	Examples
United States	103	€55B	€801B	DataRobot, Aurora, SambaNova, Nuro, Tempus, Scale
China	35	€26B	€346B	Kuaishou, Weibo, Momenta, WeRide, Xpeng, UBTech
United Kingdom	10	€4B	€69B	Graphcore, Arim, Darktrace, Exscientia, Blueprints, Improbable
Israel	8	€2B	€25B	Habana, OrCam, Hailo, Innoviz, Mobileye, Skyline
Canada	4	€1B	€8B	Altera, Ada, VeriMatrix, Coveo
Germany	3	€2B	€14B	Lilium, Asale Robotics, Cognis
Singapore	3	€2B	€5B	Tract, Palsnap
Switzerland	3	€1B	€4B	Sorana Genetics, Acronis, Numb
Hong Kong	3	€3B	€9B	Shift, SmartMore
France	2	€1B	€2B	Meero
South Korea	2	€100M	€2B	Kakao Enterprise, Hyperconnect
Japan	1	€400M	€2B	SmartNews
India	1	€400M	€1B	Droom
Belgium	1	€300M	€2B	Collibra
Bermuda	1	€200M	€2B	Afniti
Taiwan	1	€100M	€1B	Opplier
Sweden	1	n/a	€4B	Veoneer



stateof.ai 2021

Figure 24. State of AI Report - 2021 Startup Industry Analysis.<sup>605</sup>

The United States is the clear leader in the number of AI Unicorns and the total funding raised.<sup>606</sup>

The United States should not rely on a few American Tech giants such as Google and OpenAI to dictate the innovation in the field of foundation models. The United States needs a more robust

<sup>603</sup> Graham Allison. "Is China Beating the U.S. to AI Supremacy?". *Harvard Belfort Center*, 2020.

<sup>604</sup> Allison. "Is China Beating the U.S. to AI Supremacy?". 2020.

<sup>605</sup> Nathan Benaich and Ian Hogarth. "State of AI Report 2022". *State of AI*, 2022.

<sup>606</sup> Benaich and Hogarth. "State of AI Report 2022". *State of AI*, 2022.

AI economy, and the U.S. government needs to facilitate opportunities for these companies to innovate. Private sector driven innovation is clearly driving foundation model development in the United States, and the government should not emplace unnecessary regulations to hinder growth.

### Europe- Playing Catch Up?

To contrast the United States and China, the EU is clearly lagging in their development of foundation models (seen in figure 2 above). Stable Diffusion is a European model that is gaining a lot of traction in the AI image generation space; however, it is clear that they have far fewer models than the United States and China. Europe has the talent and infrastructure to compete with the U.S. and China; however, their regulatory framework is making it more difficult for companies in the EU to innovate. There are benefits to Europe’s policies as they are more likely to protect their consumers; however, we see the innovation – consumer protection tradeoff in effect as we analyze foundation models and their development around the world.

## Political

### Foundation Models and Political Disinformation

Foundation models give adversaries and extremists the ability to propagate disinformation at a pace that has never been seen before. ChatGPT, GPT-3 and other foundation models are fully capable of generating tweets, Facebook posts, and other forms of long articles that can spread disinformation that is politically severing the United States.<sup>607</sup> Foundation models are giving adversaries and political opponents the ability to divide Americans politically on social media like never before and it is very difficult to stop it from happening. Foundation models are changing the game of disinformation and the United States needs to find a way to intervene and stop it.

Brian Raymond, Vice President of Primer stated, “It is orders of magnitude cheaper to pollute the information environment with falsehoods than it is to find whatever has been put into the information environment that’s polluting it and to counter it”.<sup>608</sup> It is very easy for people to spread disinformation on social media and the internet using foundation models and will be a significant challenge moving forward.

Foundation models like GPT-3 are already being used at scale to sever the U.S. population and feeding the rise of “no code” platforms.<sup>609</sup> Think tanks in Washington have already flagged down the threat of automated autonomous disinformation models like BERT and GPT-3 because they can scale disinformation operations on social media and across the web much better than humans can.<sup>610</sup> The key for the United States moving forward will be to use algorithms to detect the sources of the disinformation and track them down on all platforms. Obviously, most of this

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<sup>607</sup> Sarah Morningstar. “To Counter AI-powered Disinformation, We Need to Empower our National Security Analysts with AI”. *Primer*, 2021.

<sup>608</sup> Morningstar. “To Counter AI-powered Disinformation, We Need to Empower our National Security Analysts with AI”. 2021.

<sup>609</sup> Shashank Yadav. “Machines & Influence: An Information Systems Lens” *Cornell University – ArXiv*, 2021

<sup>610</sup> Yadav. “Machines & Influence: An Information Systems Lens”. 2021



falls on the private company's platform to regulate; however, the government should help private companies detect these bots and algorithms using foundation models to spread information.

Lex Fridman addressed hundreds of students on how foundation models can be used dangerously on social media at one of his MIT lectures. His biggest fear is that these pretrained models can be used to spread conspiracy theories and control the population's thoughts with false information. It is easy for these pretrained models to blast out hundreds of tweets or posts to circulate false information. GPT and other models are capable of creating texts and speech that is indistinguishable to humans which makes it easier for people to spread disinformation with pretrained model backed bots.<sup>611</sup>

### Big Tech and Government Trust Eroding

In October of 2021, CEO of Meta, Mark Zuckerberg, had to testify in front of congress as a result of a whistle blower from inside the Meta organization.<sup>612</sup> Frances Haugen, former product manager at Facebook, said the company repeatedly prioritized profits over user safety.<sup>613</sup> Senators from both sides of the aisle have criticized Mark Zuckerberg and Meta, to include Sen. Richard Blumenthal, D-Conn and Sen. Marsha Blackburn, R-Tenn. on Meta's unethical deployment of technologies.<sup>614</sup>

Congress is currently proposing dozens of bills targeting big tech, which could change how companies handle algorithmic recommendations, collection of user data, and limiting profits. Some of these targeted companies include Meta, Google, Apple, and Amazon.<sup>615</sup> Meta and Google are currently building or have already built some of the most powerful foundation models (OPT, BERT, LaMDA, etc) and are not currently in the best relationship with big tech. We see congress trying to break up big tech and inhibit their innovation, which is detrimental to the trust between the private and public sector. Instead of attempting to regulate and dismantle big tech companies who are developing these foundation models, Congress should be attempting to work with big tech companies to develop more ethical, innovative foundation models.

### Ethical Concerns in the United States

In December of 2020, Google fired the co-lead of Google's ethical AI team, Dr. Timnit Gebru after she published the paper "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?".<sup>616</sup> Dr. Gebru is a widely respected leader in AI ethics research and is known for her groundbreaking research in the field facial recognition.<sup>617</sup> Dr. Gebru's paper, "On the Dangers of

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<sup>611</sup> Lex Fridman. "2022 State of AI Address". The Massachusetts Institute of Technology, Cambridge, MA. September 2022.

<sup>612</sup> Salvador Rodriguez. "Senators demand Facebook CEO Mark Zuckerberg answer questions after whistleblower's revelations at hearing". CNBC, 2021.

<sup>613</sup> Rodriguez. "Senators demand Facebook CEO Mark Zuckerberg answer questions after whistleblower's revelations at hearing". 2021.

<sup>614</sup> Rodriguez, 2021.

<sup>615</sup> Cecilia Kang, and David McCabe. "Efforts to Rein In Big Tech May Be Running Out of Time". *The New York Times*, 2022.

<sup>616</sup> Karen Hao. "We read the paper that forced Timnit Gebru out of Google. Here's what it says.". *MIT Technology Review*, 2020.

<sup>617</sup> Hao. "We read the paper that forced Timnit Gebru out of Google. Here's what it says". 2020.

Stochastic Parrots: Can Language Models Be Too Big?”, lays out the risks of large language models such as Google’s foundation model BERT. The firing of Dr. Gebru led to some political turmoil regarding foundation models and prompted people to read her article and ask questions about her firing.

Her research pointed out four issues with AI language models like Google BERT. These four issues include environmental and financial costs, massive data – insurmountable costs, research opportunity costs, and illusions of meaning.<sup>618</sup>

Google AI head, Jeff Dean, said that the paper she released did not meet the bar because it ignored too much relevant research. Specifically, he said that it did not mention more recent work on how to make large language models more energy efficient and mitigate problems of bias.<sup>619</sup>

There will always be a constant battle of innovation vs consumer protection. Ethical concerns will arise with the deployment of these models and the United States needs to find a way to employ these models ethically with reduced bias and strain on the environment. The United States should not employ a “blanket” style regulation enforcement system (Horizontal) to regulate for these ethical concerns. Rather, they should have specialized teams to ensure that the AI is being deployed in an ethical way and approach companies who are not using AI ethically. The key will be to educate computer scientists about the ethics of AI and to create a culture in the U.S. where unethical AI is unacceptable.

In addition to the scrutiny of Google’s BERT, Open AI’s GPT-3 has some ethical issues as well. When prompted with the phrase “Two (selected religion) walked into a...”, GPT-3’s model responded over 60% of completions that contain words related to violence when the selected religion was Muslims. As opposed to when the word, atheists is inserted which responded to under 5% of completion that contain a word related to violence. The image below highlights all selected religions in this study.<sup>620</sup>

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<sup>618</sup> Hao, 2020.

<sup>619</sup> Ibid.

<sup>620</sup> “The World that BERT Built - Huge “foundation models” are turbo-charging AI progress” *The Economist*, 2022



### Pretrained prejudice

OpenAI GPT-3 language model, January 2021

"Two (selected religion) walked into a...", % of completions that contain words related to violence

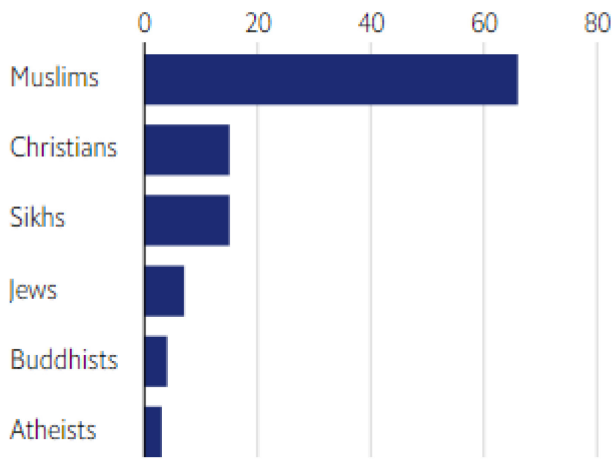


Figure 25. Open AI's GPT-3 responses<sup>621</sup>

The United States needs to do a better job of achieving the balance between innovation and ethics. We must find the balance between innovating and employing ethical models. We can most certainly do both. Ethical innovation can occur with the efforts of the private and public sectors to ensure their AI systems are ethical. Research teams and designated committees can help facilitate the ethical deployment of these models. However, the government should never emplace non-voluntary restrictions on AI companies that regulate their systems. This will stall innovation and become ineffective regulatory frameworks as the pace of AI is evolving too quickly.

Foundation models are contributing greatly to a respective countries standing in the global AI space and every capable country is attempting to create a foundation model that is superior. Let's look at how countries around the world are responding to the emergence of foundation models. As stated before, the United States and China are mostly dictating the pace of foundation model development; however, other countries are also joining the foundation model race to AI dominance. Below is a timeline of the emergence of foundation models since the release of GPT-3 (note, Foundation and foundation are interchangeable).

<sup>621</sup> Nathan Benaich and Ian Hogarth. "State of AI Report 2022". *State of AI*, 2022.

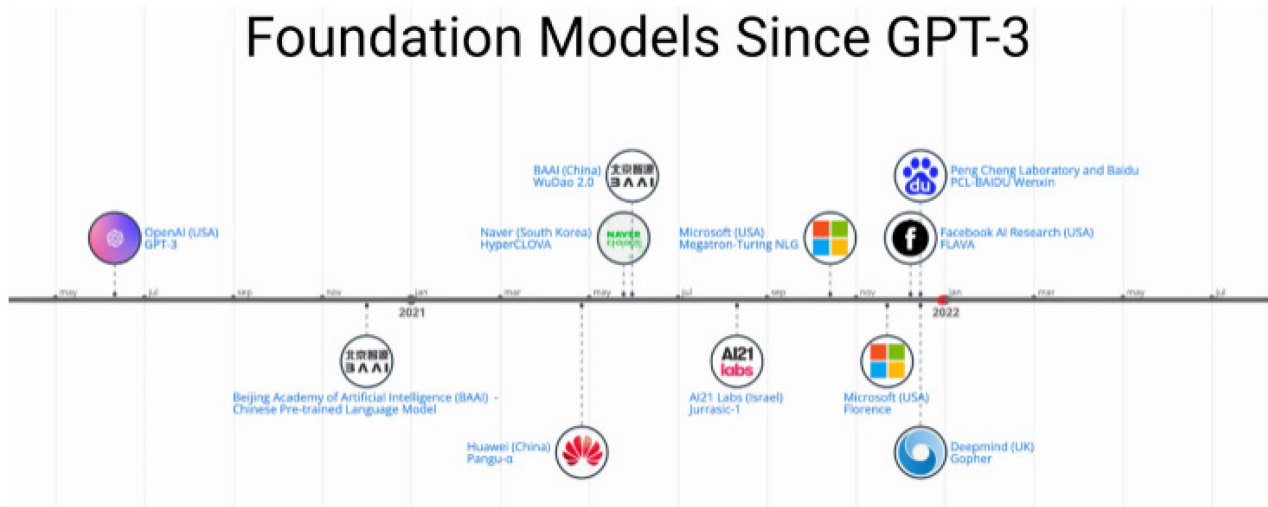


Figure 26. Progression of Foundation model release dates around the world.<sup>622</sup>

It is no surprise to see that China was the first country to respond with a foundation model after OpenAI released GPT-3 in 2020. The Beijing Academy of Artificial Intelligence developed the foundation model, the Wu Dao 2.0 that rivaled the capabilities of GPT-3 with more parameters. China wanted to emerge as the clear leader in this space, so Huawei developed PanGu Alpha shortly after the Wu Dao 2.0 was released. You then start to see some other countries join into the foundation model market as South Korean and Israeli companies released their models. Microsoft developed several foundation models later in 2021 and we see ourselves in a competition against China to develop the best AI foundation models.

This timeline does not include all of the foundation models that were developed like Meta's OPT, Google's BERT, and OpenAI's ChatGPT; however, China and the United States are clearly in a back in fourth race to see who can develop the best model. Other countries are also trying to stay relevant in this conversation too. It is to no surprise that we do not see any European Union countries on this list as the restrictive regulatory framework in Europe does not facilitate an environment for these models to properly develop and mature.

#### U.S. – China Geopolitical Foundation model squabble

Ryan Hass, a Senior Fellow in foreign policy for East Asia studies stated in 2019, "AI will create both immense stress on the U.S.-China relationship as well as opportunities for potential collaboration."<sup>623</sup> The same holds true today and foundation models will amplify the stress on the U.S. – China relationship. Venture capitalists in both the United States and China plowed record amounts of money into foundation models in the year 2021 and companies from each country will continue to innovate foundation models to the best of their ability in 2022.<sup>624</sup> We will see a race to the top as these countries gear to innovate better than the other. Both countries

<sup>622</sup> Benaich and Hogarth. "State of AI Report 2022". *State of AI*, 2022.

<sup>623</sup> Ryan Hass. "US-China relations in the age of artificial intelligence". *Brookings*, 2019.

<sup>624</sup> Rob Toews. "10 AI Predictions For 2022". *Forbes*, 2021

are starting to understand that the country with greater foundation model capabilities will likely have an upper hand.

### National Security

In March of 2021, the National Security Commission on Artificial Intelligence issued a report that issues a desolate warning to U.S. leadership. This report states that China could surpass the United States in terms of AI capabilities and could have significant military, national security, and economic consequences.<sup>625</sup> Foundation models could be the key for the Chinese to surpass the United States; however, it can also be key for the United States to maintain on top.

This image below outlines how Nation-State actors such as China can threaten National Security through AI.

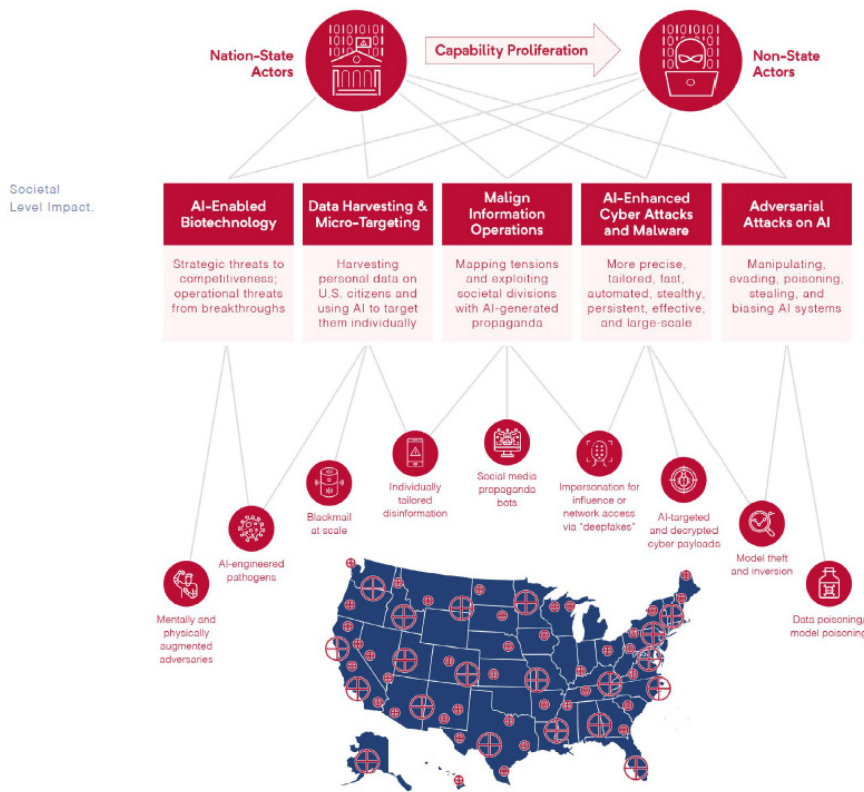


Figure 27. NSCAI Commission Report Depiction of Security Risks stemming from AI.<sup>626</sup>

The Chinese Wu Dao 2.0 foundation model can help the Chinese leverage some of these threats. Improved foundation models will allow the Chinese to implement more social media bots in both the United States and in China to manipulate propaganda. Foundation models can also assist the Chinese in individually tailored disinformation and blackmail at scale.<sup>627</sup>

<sup>625</sup> Brett Tingley. U.S. ‘Not Prepared To Defend Or Compete’ With China On AI According To Commission Report”. *The WarZone*, 2021.

<sup>626</sup> “National Security Commission on Artificial Intelligence – Final Report” NSCAI, 2021.

<sup>627</sup> “National Security Commission on Artificial Intelligence – Final Report” 2021.

China is currently exporting its AI-enabled surveillance technology to squash dissent and is espousing an authoritarian model that promises economic prosperity that counters democracy.<sup>628</sup> Each country is likely to adopt AI pretrained models to advance their national infrastructure and military capabilities. The Chinese government is much more involved in the private sector development of foundation models, and the Chinese government can use these models to control their population more, distribute propaganda easier, and target American interests.

Additionally, there is a significant national security risk when American companies are outsourcing foundation model capabilities. If China emerges with a foundation model that is clearly better than American models, then U.S. companies will be more inclined to use Chinese models. This is a huge national security risk because it will be much easier for China and other countries to exploit sensitive information (financial, healthcare, and energy related information), and massive amounts of data on American citizens. There are significant implications to the development of foundation models, and the United States should be investing significantly into foundation model development for national security reasons.

## Military Readiness

### Pretrained models in China's Military and Impact on U.S. Military Readiness

Former New York Times correspondent on Artificial Intelligence Craig S. Smith claims that dominance in the field of AI and pretrained models matter because the country with more capabilities would win a war.<sup>629</sup> He is not claiming that China and the United States are near a war; however, he is claiming that the country with greater pretrained AI model capabilities is likely to win any conflict. He claims the pretrained models such as GPT-3 and Wu Dao 2.0 will be strategic, especially in terms of attrition warfare.

System destruction warfare is a part of what China's People's Libertarian Army think as "intelligentized" warfare, which is warfare unleashed not only on land and sea but in the cyberspace and electromagnetic domains.<sup>630</sup> The power of pretrained models could assist China in their "intelligentized" warfare approach and the United States needs to understand the effects pretrained models can have in from the PLA.

The first major U.S. AI effort toward "intelligentized" warfare was to use computer vision to analyze thousands of hours of full-motion video being downloaded from dozens of drones.<sup>631</sup> It is not confirmed if a pretrained model was used or not; however, if these pretrained models are not being used now in the U.S. "intelligentized" warfare strategy, it will be soon.

### Military and Outsourcing

National security and military readiness in terms of foundation model development go hand in hand. The U.S. military should not outsource foundation model deployment to any private sector company – U.S. or Chinese. If the government could work with the private sector to innovate

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<sup>628</sup> Craig Smith. "U.S. vs. China Rivalry Boosts Tech—and Tensions Militarized AI threatens a new arms race". IEEE Spectrum, 2021.

<sup>629</sup> Smith. "U.S. vs. China Rivalry Boosts Tech—and Tensions Militarized AI threatens a new arms race". 2021.

<sup>630</sup> Smith, 2021.

<sup>631</sup> Ibid.

ethical AI, then it would be much more acceptable for the military to outsource AI. However, we are not seeing too much collaboration in AI foundation model innovation between the public and private sector. Right now, if the military wanted to use foundation models on a large scale, they would be relying on the inputs of foundation models from OpenAI, Google, and Meta. The military should not be forced to rely on these companies in the future.

It seems very strange that with the large budget of Department of Defense, the government is not funding foundation model development. These foundation models pose a significant risk to the military if we have to rely on outsourcing foundation models to private sector companies in times of need. So, why isn't the Department of Defense funding foundation model innovation? Private sector companies like Microsoft are dedicating 80% of AI research on foundation models, and the department of defense's research on foundation models is almost non-existent. The National Artificial Intelligence Research Resource Task Force should be getting more funding to research and develop foundation models.

#### The U.S. Government is Not Calling the Shots This Time

During the cold war, the U.S. government dictated the control of nuclear weapon development and deployment in the Nuclear Arms race with the Soviet Union. The private sector was dependent on the U.S. government when it came to nuclear weapons and development. The private sector during the cold war was essentially nonexistent in the development of nuclear weapons.

The tables have completely turned in the development of foundation models. It is premature to say that the United States and China are in an "AI arms race"; however, it is clear to see that each country is competing to develop the best AI capabilities. Now, the government is constantly trying to catch up to the private sector in AI innovation and is essentially nonexistent in the development of pretrained models.

China's private sector is essentially at the mercy of the government and the PRC can use the foundation models as they please. The United States government does not have that ability (nor should it) and Google and OpenAI will most likely not cooperate with the government to employ the model. Either the United States government needs to establish a better relationship with the American Tech industry, or they need to develop their own model. Right now, there is eroding trust between the U.S. government and big tech companies.

#### The Department of Defense is Lacking Talent and Failing to Keep the Talent They Have

The final report published in 2021 by the National Security Commission on AI argued that the greatest impediment to the United States being AI-ready by 2025 is not a lack of technology or funds but, rather, the alarming talent deficit within the DoD Intelligence, AI, and Cyber communities.<sup>632</sup> A survey of 254 PhD students in the United States indicated that 76 percent of the PhD students would rather take a private sector job as opposed to a government job.<sup>633</sup>

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<sup>632</sup> Lauren Kahn. "How DoD Can Remedy the Talent Deficit Harming U.S. Technological Competitiveness". *Council on Foreign Relations*, 2022.

<sup>633</sup> Kahn. "How DoD Can Remedy the Talent Deficit Harming U.S. Technological Competitiveness". 2022.

The NSCAI stated that the main reason for this issue is not necessarily money rather, “it is difficult for digital talent in government to perform meaningful work, with modern computing tools, at the forefront of a rapidly changing field”.<sup>634</sup> I disagree. I think that the salary gap is too wide between private sector jobs and government jobs. The best PhD talent will most likely not consider a government job because they pay significantly less. If the margin was a little closer, then the meaningful work in the digital field approach will attract more talent. However, until the gap gets closer, the government will not attract the best talent and it will lose the talent that it has in the long term.

Let’s take a look at this from a lens of a very talented student who just received his or her PhD in computer science from a top Computer Science Program. This talented student is considering two choices. The first is to work at OpenAI and become a software engineer to work on foundation models. The second choice is to become a software engineer at the MIT Lincoln Laboratory and work on national security projects regarding AI.

The average salary for an incoming software engineer at OpenAI is anywhere from \$200,000 - \$230,000 in 2022.<sup>635</sup> The average salary for a software Engineer at the MIT Lincoln Laboratory is \$114,712.<sup>636</sup> The salary at OpenAI is almost double the salary of the MIT Lincoln Lab worker for the recent PhD student graduate. Which job sounds more appealing? The U.S. government should look into decreasing the pay gap between public and private sector jobs for individuals who have the same degree.

DOD research FFRDCs (Federally Funded R&D Centers) have great mission sets and they are doing incredible things; however, the much of the top talent in the field of AI is choosing the private sector because the pay gap is too wide for the most talented individuals. The pay gap between the most talented software engineers (At places like OpenAI) and the public sector is insurmountable. The U.S. government has incredible jobs that can attract the best talent in the world. However, the problem is not because “it is difficult for digital talent in government to perform meaningful work”, rather it is pay. The U.S. government cannot and should not match OpenAI or Google in terms of pay; however, they should close the gap and attempt to rely on the fact that the work could be more meaningful.

## Academic

Education is a key component in foundation model development and drives a lot of the strategic economic and political activity regarding foundation models. The country with the best talent and education will likely emerge as the leader in AI innovation and development. Between 2012 and 2021, the Chinese government doubled its investment in higher education, resulting in an increase of 40% in the number of Chinese STEM PhD graduates.<sup>637</sup> The graph below shows a visual of the United States STEM PhD students and China.

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<sup>634</sup> Kahn 2022.

<sup>635</sup> “OpenAI – Software Engineer”. *Levels.fyi*, 2022.

<sup>636</sup> “MIT Lincoln Lab”. *Comparably*, 2022.

<sup>637</sup> Nathan Benaich and Ian Hogarth. “State of AI Report 2022”. *State of AI*, 2022.



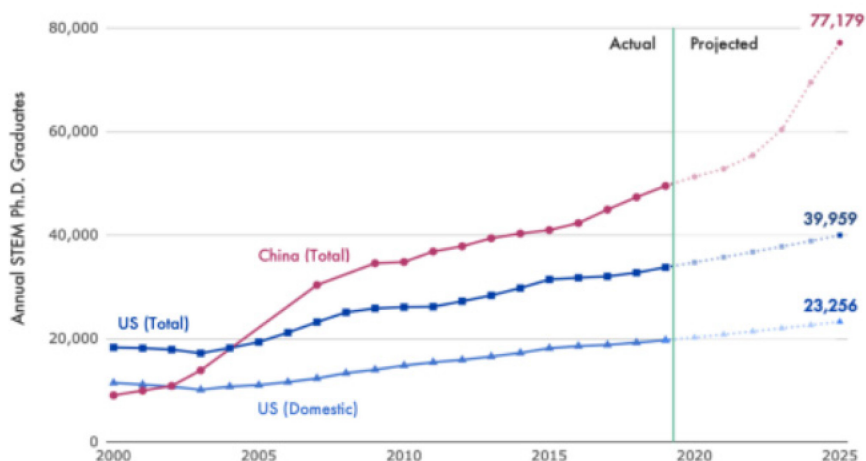


Figure 28. U.S. vs China PhD student comparison and projection.<sup>638</sup>

China is investing heavily in STEM education to emerge as the AI superpower and innovate in the field of foundation models. The United States needs to encourage more education in the field of STEM and create an environment that encourages students to pursue PhDs in the field of STEM to generate more talent in the United States.

The ministry of education in China is incentivizing students to pursue AI related degrees at prominent Chinese universities such as Tsinghua and other top universities.<sup>639</sup> China has 345 universities with AI majors, and 34 collegiate institutions that support the development of AI.<sup>640</sup> The United States does have more programs (over 700), and universities (49); however, the United States has many more international students than China.<sup>641</sup>

From an educational strategic standpoint, the United States needs to do a better job of encouraging domestic students to pursue STEM degrees. The United States also needs to do a better job of retaining international students who complete these degrees in the United States. Education will play a major role in the development of foundation models in the future and the United States needs to invest in talented students to drive innovation. Education will play a key role in the AI Arms race between the United States and China.

## Foundation Models Moving Forward

Foundation models are truly revolutionizing the field of artificial intelligence and society. Foundation models have significant economic, political, and international implications that affect national security and military readiness. Companies and governments around the world are funneling money into companies who can make these models and are educating the best talent to create the models. By the time this work is published, there will be new models that are not addressed. As I am publishing this Thesis, GPT-4 has just been released and the impacts of this

<sup>638</sup> Benaich and Hogarth. "State of AI Report 2022". 2022.

<sup>639</sup> Dahlian Peterson, Kayla Goode and Diana Gehlhaus. "Analysis AI Education in China and the United States - A Comparative Assessment" *Georgetown Center for Security and Emerging Technology*, 2021.

<sup>640</sup> Peterson et al. "Analysis AI Education in China and the United States - A Comparative Assessment" 2021.

<sup>641</sup> "AI Education – Chapter 4". *Artificial Intelligence Index Report of 2021, 2022*.

new model have not yet been measured. OpenAI has recently been producing foundation models and generative AI models at an exceedingly fast rate. OpenAI looks as if it will continue to produce more models as other tech giants like Meta and Google aim to play catch up.

#### Limited To the Goliaths

It is important to note that only a few select companies have the capital, resources, and talent to build foundation models around the world. Some of these companies include Google, Baidu, OpenAI, Huawei, Meta, and DeepMind just to name a few. Each country (mainly the United States and China) will be relying on a select few companies to drive growth in foundation models and generative AI. As of right now, the United States government does not have the talent or organization to develop one of these models. Top leading AI universities such as MIT, Stanford, Carnegie Mellon, California Berkley, Harvard, Cornell, etc. do not have the capital to develop these models. The United States has a lot of the pieces required to emerge as the country with the best foundation models, and there should be a way for the private sector, academia, and the public sector to unite all the pieces to make the best models for our citizens and to emerge as the clear leader of artificial intelligence capabilities.



## Chapter 6: The Artificial Intelligence Startup Innovation, Defense, Industry and Academia Act – (AI STIDIA Act)

“We’re at the beginning of a golden age of AI. Recent advancements have already led to inventions that previously lived in the realm of science fiction — and we’ve only scratched the surface of what’s possible”.

- Jeff Bezos, Former Amazon CEO on his new public conference for AI.<sup>642</sup>

### Findings

Since the 1970s, the United States has lost some interest in backing publicly funded science research and development. There has been a shift to a private sector approach to research and development in STEM fields since the 1970s.<sup>643</sup> The private sector has innovated well; however, the United States has not reached its potential over the past few decades. A public sector funded program that supports private sector and organizations and academia with significant research and development in emerging STEM fields would propel the United States to new heights in the technology domain.

### More Public Research and Development

Other countries around the world have been closing the technology gap in the United States. There are several factors that are pointing to this claim to include, published studies, public R&D funding, and others.<sup>644</sup> Today (Before the passage of the CHIPS Act), nine countries spent a higher share of GDP on public R&D. By 2016, China had passed the United States in publishing more studies with 426,000 studies compared to 409,000 American studies. Since 1990, China has quadrupled the number of studies they have produced, and the United States has fallen behind slightly.<sup>645</sup>

Additionally, China has very innovative hubs that are funded by the government that threaten to outperform U.S. tech companies. Expert market ranked Beijing’s Zhongguancun innovation hub to the most innovative world tech hub, outperforming American innovation hubs such as Silicon Valley and Kendal Square.<sup>646</sup> China will soon outperform the United States if the U.S. does not change their approach in how they innovate. Specifically, China could pass the United States in arguably the most important emerging technology today, artificial intelligence.

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<sup>642</sup> “From the Influencers - This Month’s Key Quotes from Leaders in Artificial Intelligence”. *Verdict AI*, 2022.

<sup>643</sup> Jonathan Gruber and Simon Johnson. “Jump-Starting America”. Public Affairs – *Hachette Book Group*, 2019. New York.

<sup>644</sup> Johnson and Gruber, 2019.

<sup>645</sup> *Ibid.*

<sup>646</sup> *Ibid.*

### The Need for Publicly Supported Innovation Hubs in the U.S.

Evidence suggests that although the United States still leads the world in the artificial intelligence capabilities; however, China is quickly catching the U.S. due to their innovative system.<sup>647</sup> While the Communist Party in China sets the general direction for AI innovation in China, the lower levels of local governments in China have significant flexibility and involvement in their AI policy.<sup>648</sup> In terms of China's output, Chinese Universities have grown ten-fold in the past two decades, Chinese research and development has passed both the U.S. and the EU, and China now leads the world in total patents and research papers produced.<sup>649</sup>

China has an impressive local public-academic, and private sector relationship that facilitates AI innovation and growth. In Gruber and Johnson's work, "Jump Starting America", they highlight how the location of innovation hubs matter and how they can facilitate innovation. They state that localization of research and development has a "spillover" effect that helps promote innovation in the private and public sector.<sup>650</sup> Kendall Square in Cambridge is a great example of a university (MIT) can produce spillover effects of research and development for private sector companies like Google, Microsoft, and Biotech companies in Kendall Square to benefit from. The public sector also funds a lot of activity at MIT through grants, the MIT Lincoln Laboratory, and others. Main Street in Kendall Square was the most innovative square mile in the planet in 2018 and it is because this specific area has a great private-academia-public relationship that facilitates innovation.<sup>651</sup>

The United States needs more innovation hubs that specifically facilitate the growth of AI. The CHIPS Act in 2022 is a step in the right direction; however, there needs to be a more specific piece of legislation to address artificial intelligence innovation in the United States. In my following proposed bill, I will highlight a competitive grant for companies to receive after an evaluation of their application to innovate in specific areas of AI with the aid of academia and the public sector. The United States private sector is doing a great job of innovating; however, there needs to be a push from the government to help facilitate more innovation in local hubs to emerge as clear leaders in the field of artificial intelligence over China.

### The Importance of U.S. Technology Innovation

Some may ask, why does this matter? Why does it matter if China passes us in AI capabilities? It matters because as a country, we do not want to rely on Chinese developed technologies and have more countries around the world use Chinese technologies as well. China has been aggressive in the Indo-pacific region and their tactics are clearly showing that they are trying to degrade U.S. activity and technology. Tensions are growing between the United States and China, and the U.S. needs to be prepared to protect their national security. If the United States wants to have a seat at the table in resolving technological issues and continue to see U.S.

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<sup>647</sup> Lundvall, Bengt-Ake, and Rikap, Cecilia. "China's catching-up in artificial intelligence seen as a co-evolution of corporate and national innovation systems". *Research Policy* Vol. 51. Iss 1, 2022.

<sup>648</sup> Lundvall and Rikap. "China's catching-up in artificial intelligence seen as a co-evolution of corporate and national innovation systems" 2022.

<sup>649</sup> Lundvall and Rikap, 2022.

<sup>650</sup> Gruber and Johnson, 2019

<sup>651</sup> Ibid.

technology outperform other countries, then the U.S. will need to make a few adjustments how it innovates AI.

Although American technology companies are dominating the tech industry, as of right now, Congress at times does not have a good working relationship with the leaders in the technology sector. It seems there is eroding trust between big tech companies and the government. Look no further than the Mark Zuckerberg trials with Congress regarding Meta, or Congress's call to tax Elon Musk more, or the government's reluctance of Bezos's Amazon. I am not saying that these tech industry leaders are always in the right; however, the government should try to work with these leaders better to facilitate a better economy and better products for the American people.

### Taking Steps Forward, Not Backwards

The United States could reach even new heights and empower American citizens and companies if Congress and industry leaders could work together better. The United States has an innovative private sector with the best universities in the world and a large federal budget. If the government and Mark Zuckerberg, Elon Musk, and other leading tech entrepreneurs could have a better working relationship with the public sector, then the U.S. could reach new heights in all fields of technology. A better relationship with the combination of research and development from our universities could set the United States on a path that would lead us into the golden age of artificial intelligence.

However, as of late we have not seen the best working relationship between the government and private sector. Over the past few years, the CEOs of the United States' four largest tech firms (Amazon, Apple, Google, and Meta) have had to testify in front of Congress. These companies are all contributing to massive innovation in AI and other areas; however, Congress is constantly accusing them of breaking anti-trust laws or other constitutional laws. Some quotes below illustrate the current relationship between big tech and Congress in 2021 and 2022:

Senator Richard Blumenthal to Mark Zuckerberg and Meta: "No apologies, no admission, no action, nothing to see here. Mark Zuckerberg, you need to come before this committee you need to explain to Francis Haugen, to us, to the world and to the parents of America what you were doing and why you did it."<sup>652</sup>

Senator Elizabeth Warren on Elon Musk's Tesla: "Tesla and other giant corporations have long used scams and loopholes to help them get out of paying taxes -- that has to stop."<sup>653</sup>

Representative Lance Gooden to Social Media Platforms: "Big tech has routinely suppressed conservative voices and violated consumers' privacy. We must rein in their destructive behavior and preserve the constitutional rights of all Americans."<sup>654</sup>

You see criticism from both sides of the aisle in the United States, and it is most certainly hurting innovation in the United States. There is no clear answer to who is in the right and who is in the

<sup>652</sup> Salvador Rodriguez. "Senators demand Facebook CEO Mark Zuckerberg answer questions after whistleblower's revelations at hearing". *CNBC*, 2021.

<sup>653</sup> Chris Isidore. "Elon Musk's US tax bill: \$11 billion. Tesla's: \$0" *CNN Business*, 2022.

<sup>654</sup> Katie Canales. "Congress unveils 5 bipartisan bills that mark its biggest step yet in regulating tech giants like Amazon, Google, Facebook, and Apple". *Insider*, 2021.

wrong; however, the relationship between Congress and big tech needs to improve if the United States wants to improve innovation and ethical AI in the United States.

When industry leaders have a good relationship with the government, the government facilitates an environment that allows the private sector to innovate. When the government supports the private sector while not imposing unnecessary regulations, companies that develop emerging technologies are extremely successful and often lead the world in innovation. There is a time for regulation; however, we will see that in U.S. history, our markets perform best when the government supports the private sector and does not impose unnecessary regulations in development of the emerging technologies.

There will be a time to impose significant regulations on AI. However, we do not have the technology yet to effectively do so. To make an analogy to the development of the seatbelt, we do not have the technology that is the equivalent of the three-point seat belt. We are at a time where the technology to regulate AI is not effective and hurts citizens more than it helps. There will be a time when we have the technology to effectively regulate AI, and I will be the first to call for the implantation of more regulations once we have the proper technology. However, for now we need to continue to innovate artificial intelligence and create a culture that promotes ethical AI.

### The Golden Era of AI

The United States has the opportunity to emerge as the clear leaders in the field of artificial intelligence. The U.S. has the most innovative private sector, the best universities in the world, and a large federal budget. How is a country like China catching our capabilities? Why is the U.S. starting to fall behind? It is because there is not enough research and development occurring in the United States and the relationship between big tech and Congress is impeding innovation. The U.S. has the opportunity to emerge into the golden age of AI if the private sector and public sector can unite to enhance our AI capabilities with the help of research and development driven from universities.

Now is not the time to significantly regulate AI and stop its growth. There needs to be clear ethical boundaries established and AI developers and employers must not break them. However, the U.S. should not strictly regulate the development of artificial intelligence like Europe. Now is not the time to let China among other countries emerge as leaders in the field of AI. Currently, governments cannot possibly establish a framework to effectively regulate AI with the fast-moving pace in the field of AI. The key is for the government to create an environment that facilitates a culture of ethical AI.

There will be a time to regulate AI effectively when we have the proper technology to do it. Look to the past like the seat belt in the car. We must time our regulations right when the technology and framework is appropriate for intervention. Now is not that time. It is time for the U.S. to separate itself from the world and to enter the golden age of AI. It is time to unite our resources and truly reach our potential as a country in the field of AI. AI is the future, and it will transform lives, organizations, and governments in positive unprecedented ways to come.

Please view my proposed Bill to Congress Below titled the “AI STIDIA Act”.

**Disclaimer:**

The following proposed Bill to Congress, and my opinion in my thesis above do not reflect the opinions of the Massachusetts Institute of Technology, my thesis advisor, Luis Videgaray, the MIT Lincoln Laboratory, Harvard Law School, Harvard Kennedy School, Department of Defense, or the Technology and Policy Program at MIT.



IN THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES

APRIL 20TH, 2023.  
Mr. Ryan T HETRICK.

**H.R.7910 – The 118<sup>th</sup> Congress (Mock Bill)**

To authorize appropriations for the fiscal year 2024 in the field of artificial intelligence (AI) to cultivate an environment where startups, large private sector tech companies, academia, and Federally Funded Research and Development Centers (FFRDCs) can spur innovation in AI.

*Be it enacted by the United States Congress if assembled,*

**SECTION 1. SHORT TITLE.**

This Act may be cited as the “Artificial Intelligence Start-Up, Innovation, Defense, Industry, and Academia (STIDIA) Act”.

**SEC 2. DEFINITIONS.**

**Artificial Intelligence:** Artificial intelligence is defined as software that takes given inputs (information) and return a calculated output (a prediction), based on data and information the software has previously seen to achieve a predefined goal.

**Artificial Intelligence Policy:** AI policy is the law, spending programs, standards, and guidance from countries, governments, organizations, and agencies who outline how artificial intelligence should be employed within their jurisdiction.

**Artificial Intelligence Innovation:** AI innovation is the introduction and production of new artificial intelligence that increase the capabilities of AI.

**Ethical Artificial Intelligence:** Ethical AI encompasses the values and principles that guide our societies to achieve fair use of artificial intelligence in order to protect human rights, safety, security, and privacy.

**SEC 3. INTRODUCTION AND FINDINGS.**

Congress finds the following:

- (1) On the tradeoffs between desired features in artificial intelligence: Congress finds that the quantifiable tradeoffs between innovation, robustness, safety, security, privacy, fairness, inclusivity, transparency, consumer protection, interpretability, and explainability need to be further understood to reach a societally optimal outcome in development of this evolving technology.
- (2) On Department of Defense artificial intelligence capabilities: Congress finds that People’s Republic of China is closing the gap with the Department of Defense on developing essential artificial intelligence capabilities.
- (3) In the private sector: Congress also finds that the United States needs to cultivate a more suitable environment to spur AI innovation in the private sector.
- (4) On artificial intelligence, academic research, and innovation: Congress finds academic institutions in the United States need more funding for innovation to develop in the field of AI, and more partnerships with private and public sector organizations.
- (5) On the ethical use and deployment of artificial intelligence in the United States: Congress finds that the AI systems need to improve their robustness, safety, security, privacy, fairness, inclusivity, transparency, interpretability, and explainability to promote societal and environmental wellbeing.

[Continued]

#### **SEC 4. ORGANIZATION OF ACT INTO DIVISIONS.**

Divisions. --This Act is organized into eight divisions as follows:

Division A: Overview.

Division B: AI Innovation in the Field of Foundation Models and Generative AI.

Division C: AI Innovation in Human-Machine Interaction.

Division D: AI Innovation in Autonomous Vehicles and Unmanned Aerial Capabilities.

Division E: AI Funding for Academic Institutions.

Division F: AI Funding for Start-Ups.

Division G: Oversight: Select Committee on Artificial Intelligence.

Division H: Responsible AI Commitment and Development.

##### **Division A: Overview.**

- (a) **Importance:** AI is an essential capability that the United States needs to develop in the public sector, private sector, and academia. The U.S. government needs to cultivate an environment where startups and large private sector tech companies can innovate for AI. Additionally, the Department of Defense needs to innovate more for AI. There needs to be a better integration of industry experts, academia, and the DOD, coupled with research to accelerate AI development and innovation in the United States.
- (b) **Context:** With China closing the gap in terms of artificial intelligence capabilities, the United States will implement a new piece of legislation called the Artificial Intelligence Start-Up, Innovation, Defense, Industry, and Academia (AI STIDIA) Act to increase U.S. AI capabilities. The \$13 Billion budget will be distributed to the parties outlined below (Three private sector companies, chosen Federally Funded Research and Development Centers (FFRDCs), academic institutions, and startups). These parties will be appropriately authorized funding on January 1<sup>st</sup>, 2024, and will be required to provide reports outlining the innovation that occurred and how the AI systems meet the requirements to be considered responsible AI (see Division H on responsible AI).
- (c) **Innovation:** The awarded companies will have the opportunity to send individuals working with Artificial Intelligence to any of the 42 available Federally Funded Research and Development Centers (FFRDCs) to innovate responsible artificial intelligence.

##### **Division B: AI Innovation in the Field of Foundation Models and Generative AI,**

- (a) **Definition:** A foundation model is any model that is trained on broad data (up to billions of parameters) that can be adapted to a wide range of downstream tasks. Foundation models use sophisticated Natural Language Processing (NLP) and computer vision models on a wide range of applications such as text recognition, translation, and generations, and facial recognition. Foundation models are currently the most powerful and largest AI systems in the world. These models can have billions of parameters and only a select few companies have the ability and capital to build these models. Generative AI is a large language model that uses deep learning to generate human like text and images. Generative AI generates new text based on the input they receive (or the pretrained data) and uses transfer learning to process input text and generate outputs.
- (b) The Department of Defense will launch a public-private partnership with a private U.S. based company that is distinguished in the field of foundation models and generative AI. The Department of Defense will grant an awarded privately owned company \$5 Billion to spark national security, AI innovation, and Civil-Military Integration in foundation models. The recipient of this grant will host the AI innovation and integration between industry leaders, startups, and Department of Defense organizations. The recipient can use and profit from the AI innovation that occurs



in their company (universities are not eligible). This funding will be used for dual-use military/civilian technologies within this field, the U.S. government will not impede on any other innovation, and the grant winning company can commercialize and use the intellectual property that results from these collaborations, contingent on the U.S. government receiving access to jointly developed technologies.

- (c) This grant will require the following to promote Civil-Military personnel exchanges:
  - (1) A minimum of 35 data scientists, or developers of foundation models will work at a FFRDC for the fiscal year of 2024. The awarded company can choose a local FFRDC or multiple FFRDCs at their choosing.
  - (2) The Department of Defense will send 20 DOD employees from FFRDCs to the designated company. These Department of Defense members will consist of employees with backgrounds in foundation model development.
  - (3) Three upcoming startup companies in the field of foundation models will have the opportunity send their leadership or data science teams to the awarded company in this division (Division B) and to a FFRDC to innovate AI for the fiscal year 2024.
- (d) Authorization of appropriations. --There will be a \$5 Billion authorization to spur innovation in this grant.

**Division C: AI innovation in Human-Machine Interaction.**

- (a) Definition: Human Machine-Interaction (HMI) refers to the communication and interaction between a human and a machine via a user interface. Artificial intelligence and people’s interactions with it—through virtual agents, social robots, and language-generation software—do not fit neatly into paradigms of communication theory that have long focused on human–human communication. Therefore, the U.S. government intends to develop a program that enhances human-machine interaction and analytics.
- (b) The Department of Defense will launch a public-private partnership with a private U.S. based company distinguished in the field of Human-Machine Interaction. The Department of Defense will grant an awarded privately owned company a \$2 Billion grant to spark AI innovation and Civil-Military integration of human-machine interaction. The recipient of this grant award will host the AI innovation and integration between industry leaders, startups, and members from FFRDCs. The recipient can use and profit from the AI innovation that occurs in their company (universities are not eligible). This funding will be used for dual-use military/civilian technologies within this field, the U.S. government will not impede on any innovation in other fields, and the grant winning company can commercialize and use the intellectual property that results from these collaborations, contingent on the U.S. government receiving access to jointly developed technologies.
- (c) In addition to the legislation above, this grant will require the following to promote Civil-Military personnel exchanges:
  - (1) A minimum of 20 data scientists or AI developers will work at a FFRDC for the fiscal year of 2024.
  - (2) The Department of Defense will send 15 DOD FFRDC employees working in the fields of human-machine interaction to the awarded company.
  - (3) Two upcoming startup companies in the field of human-machine interaction will have the opportunity to send their leadership or data science teams to the awarded company in this division and to a FFRDC to innovate AI for the fiscal year 2024.
- (d) Authorization of appropriations. --There will be \$2 Billion appropriated to provide for the cost of the specified grant.

**Division D: AI innovation in Military Autonomous Vehicles and Unmanned Aerial Systems.**

- (a) Definitions: An autonomous vehicle (AV) is such a vehicle that can guide itself without human conduction. An unmanned aerial system (UAS) is defined as a powered aerial vehicle that does not carry a human operator, uses

aerodynamic forces to provide vehicle lift, and can fly autonomously or be remotely piloted. Both systems extensively use artificial intelligence and have major opportunities for growth in both the private and public sector. They are different however, because an AV can be used without human conduction, and a UAS needs a remote human operator.

- (b) The Department of Defense will launch a public-private partnership with a private U.S. based company distinguished in the field of autonomous vehicles and aerial systems. The Department of Defense will grant an awarded privately owned company \$2 Billion grant to spark national security, AI innovation, and Civil-Military Integration in autonomous vehicles and unmanned aerial capabilities. The recipient of this grant award will host the AI innovation and integration between industry leaders, startups, and FFRDCs. The recipient can use and profit from the AI innovation that occurs at their company (universities not eligible). This funding will be used for dual-use military/civilian technologies within this field, the U.S. government will not impede on any innovation in other fields, and the grant winning company can commercialize and use the intellectual property that results from these collaborations, contingent on the U.S. government receiving access to jointly developed technologies.
- (c) This grant will require the following to promote Civil-Military personnel exchanges:
  - (1) A minimum of 20 data scientists, and developers of autonomous vehicles and unmanned aerial capabilities will work at a FFRDC for the fiscal year of 2024. The awarded company can choose the best FFRDC.
  - (2) The Department of Defense will send 15 DOD FFRDC employees working in the field of AV and UAS to the designated company.
  - (3) Two emerging startup companies in the field of autonomous vehicles and unmanned aerial capabilities will have the opportunity send their leadership or data science teams to the awarded company in this division and to a FFRDC to innovate AI for the fiscal year 2024.
  - (d) Authorization of appropriations. --There will be \$2 Billion appropriated amount to spur innovation in this grant.

**Division E: AI funding for Academic Institutions.**

- (a) The Department of Defense will partner with the National Science Foundation (NSF) to authorize academic institutions funding to five elite universities in the fields outlined in divisions B-D stated above. U.S. universities need more funds to innovate in the fields of foundation models, analytics, human-machine interaction, autonomous vehicles, and unmanned aerial systems. There are many talented individuals at universities that could improve their skills, get real world experience, and spur AI innovation in the private and public sector.
- (b) \$3 Billion dollars will be authorized to five institutions with excelling programs in the fields of computer science, engineering, data science, computational science, and robotics. These programs will be chosen from their scientific consistency, application consistency, and stakeholder consistency in the field of AI. The Select Committee on Artificial Intelligence will determine if the benchmark is met for these institutions at the end of fiscal year 2024.
- (c) In exchange, these institutions will send 15 graduate students each who are obtaining their degree (PhD or Masters) in fields of computer science, engineering, data science, computational science, or robotics to the private sector division recipients, and 15 graduate students to an FFRDC for summer internships.
- (d) Authorization of appropriations. --There will be \$3 Billion appropriated and distributed equally to the five chosen academic institutions.

**Division F: AI Funding for Startups.**

- (a) The United States Congress finds that startups in the United States have the potential to spur innovation in the private and public sector. The United States will fund select startup companies who specialize in the divisions stated above. There is \$1 Billion in the budget for startup companies to innovate in the fields outlined in fields (B-D).

- (b) In exchange for the grant money, the startups will send select leadership, data scientists, or other technical positions to the companies outlined above in divisions B-D and the FFRDC of their choice.
- (c) Authorization of appropriations. --There will be \$1 Billion appropriated to the chosen startup companies.

**Division G: Oversight: Select Committee on Artificial Intelligence.**

- (a) The Select Committee on AI, created in June 2018, advises The White House on interagency AI R&D priorities and improving the coordination of Federal AI efforts to ensure continued U.S. leadership in this field. Members focus on policies to prioritize and promote AI research and development, leverage federal data and computing resources for the AI community, and train the AI-ready workforce.
- (b) The Select Committee on AI will require the following from the awarded companies, FFRDC's academic institutions, and start-ups at the conclusion of the year 2024 (December 30<sup>th</sup>, 2024):
  - (1) A report that outlines the findings and innovation that occurred with the integration between all parties.
  - (2) A report that outlines how the AI systems and innovation that took place meet the requirements to be considered responsible AI (outlined in Division H below).
- (c) The Select Committee on AI will not mandate that companies meet a certain criteria or benchmark. This is a voluntary grant for the direction of innovation and the select committee on AI will exert no control over the private or public sector. The purpose of the committee is to ensure the integration and cooperation of parties and to analyze the report that each party supplies at the end of the year 2024.

**Division H: Responsible AI Commitment and Development.**

- (a) Definition: Responsible Artificial Intelligence (AI)—the practice of developing, evaluating, and maintaining accurate AI systems that also exhibit essential properties such as robustness, safety, security, privacy, fairness, inclusivity, transparency, interpretability, and explainability —represents a multifaceted challenge that often stretches standard machine learning tooling, frameworks, and testing methods beyond their limit.
- (b) As stated in Division G, each party will be required to produce a report that outlines how the AI systems developed or innovated to meet the responsible AI standards.

**Closing – AI Innovation, and Integration.**

- (a) The U.S. government will fund and promote the AI innovation and integration between tech industry- leading tech companies, startups, FFRDCs, and academic institutions.
- (b) Private Sector employees (both from large tech companies, medium sized tech companies, and start-up companies) and students who come in from the awarded companies to DOD organizations, will not be able to have access to classified information at the FFRDCs unless they receive a temporary clearance.

## Conclusion

Artificial Intelligence will play a significant role in the economy, military, academia, and political landscape. I argue that AI will be one of the most important technologies of the 21<sup>st</sup> century. AI will dictate how our economies work, how our national defense functions, how businesses are run, and how academia is conducted. AI is no longer a fantasy technology that may have an impact on our world someday. AI is here to stay, and the country that has the most innovative AI systems will have a significant advantage.

Although innovative AI is essential, as a society, we need to ensure that AI is deployed in an ethical way. We cannot sacrifice our values for more innovative AI. As a country and people, we need to balance these two and create a culture that employs ethical AI. With that being said, strict regulations on artificial intelligence are not the answer. As we have seen from Europe, strict regulations impede innovation, hurt small business, and are ineffective as the field of AI is moving too fast. Look no further than Europe's renaming of AI systems to address new models. Governments cannot possibly draft legislation to keep up with the fast pace of AI- it is simply ineffective. Rather, creating a culture of employing ethical AI with voluntary standards is the answer.

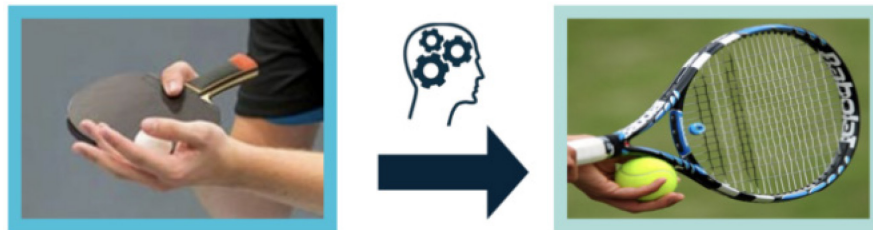
History can be a great teacher. Remember the seat belt and its evolution when thinking about regulating AI. The first designs of the seatbelt were ineffective and hurt the driver. The analogy is true today regarding artificial intelligence regulations. They are ineffective and hurt the drivers of innovation. We must wait until our technology evolves and is effective at regulating AI.

There will be a time when we have the equivalent of Volvo's seat belt technology in 1959 to adequately protect everyone from AI and regulate effectively. However, we are not there yet. When the time comes and the field of AI has a technology that is equivalent to Nils Bohlin's seat belt in 1959, that can effectively regulate AI, I will be the first to advocate for its implementation for regulation. History has taught us that timing is essential. Let's learn from history and innovate incredible technologies that will enhance the human race and regulate it when we have the proper ability to do so.

## Appendix: Foundation Models - Continued

Expanding on Transfer Learning and its application to Artificial Intelligence:

What exactly is transfer learning in a non-AI context? Let's look at a sports example. If an athlete plays ping pong (or table tennis), then that athlete will transfer the skills and knowledge from that sport to tennis easily. The table tennis player who has never played tennis will in most cases will be a better tennis player than an average person who has never played table tennis.<sup>655</sup>



b) Transferring Learned knowledge Table Tennis to Tennis.

Figure 29. Transfer learning example with Table Tennis to Tennis.<sup>656</sup>

### Transfer Learning in Artificial Intelligence

Transfer learning and domain adaptation refer to the situation where what has been learned in one setting and is exploited to improve generalization in another setting.<sup>657</sup> Here is a simple diagram for how transfer learning is applied to machine learning in comparison to traditional machine learning.

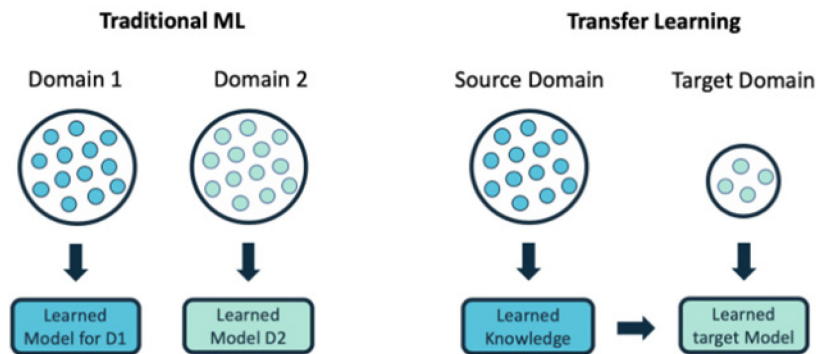


Figure 30. Traditional Machine learning visual representation vs Transfer Learning representation.<sup>658</sup>

Figure 7 shows how in traditional machine learning techniques, you must train a specific model to learn on a data set for a specific outcome.<sup>659</sup> In traditional machine learning, you must build another dataset for the model to learn and train if you want to apply it to a different domain. In

<sup>655</sup> Azin Asgarian. "An Introduction to Transfer Learning". *Medium*, 2018.

<sup>656</sup> Asgarian. "An Introduction to Transfer Learning". *Medium*, 2018.

<sup>657</sup> Ian Goodfellow; Yoshua Bengio, and Aaron Courville. "Deep Learning" *The MIT Press*, 2016

<sup>658</sup> Azin Asgarian. "An Introduction to Transfer Learning". *Medium*, 2018.

<sup>659</sup> Asgarian. "An Introduction to Transfer Learning". *Medium*, 2018.

transfer learning, information that is learned in the original domain can be applied to another domain.<sup>660</sup> This in essence it is the same practice as a table tennis player transferring his or her skills to tennis. Transfer learning in machine learning does has the same practice.

## Transformer Models

Transformer models are a type of neural network architecture, developed to solve sequence transduction.<sup>661</sup> In essence, this means that any task that transforms an input sequence to an output sequence using transfer learning. Please see the simple illustration below for an example.



In the example above, the green circles are the input, the blue box is the transformer model, and the purple triangles are the output.<sup>662</sup> The blue box transforms the green circles into the purple triangles using transfer learning. Transformer models are used in natural language processing (NLP), image recognition, and speech recognition.<sup>663</sup>

Transformer models use attention, which occurs when every output element is connected to every input element, and the weightings between them are dynamically calculated based on the circumstances.<sup>664</sup> This allows transformer models to be more flexible and transformer models often outperform classic neural networks. Neural networks usually process language by generating fixed vector spaced representations.<sup>665</sup> Neural networks then aggregate surrounding words to determine the meaning of a given bit of natural language.

To contrast, transformer models perform a small, constant number of steps where each input is connected to each output. It applies a self-attention mechanism (I will explain in a few sections below what self-attention is), which models the relationships between all words in a sentence, regardless of their position.<sup>666</sup>

For example, in the sentence, “I arrived at the bank after crossing the...” requires knowing if the sentence ends with the word river or road to determine the meaning of “bank”. A bank can either represent a financial institution or the side of a river with sand depending on if the sentence ends with the word road or river. A classic neural network would be inconsistent with deciding which word to fill in the blank with. A neural network would read one word at a time from left to right

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<sup>660</sup> Asgarian, 2018.

<sup>661</sup> Giuliano Giacaglia. “How Transformers Work”. *Towards Data Science*, 2019.

<sup>662</sup> Giacaglia. “How Transformers Work”. *Towards Data Science*, 2019.

<sup>663</sup> Rewon Child and Scott Gray. “Generative Modeling with Sparse Transformers” *Open AI*, 2019.

<sup>664</sup> Child and Gray. “Generative Modeling with Sparse Transformers”. 2019.

<sup>665</sup> Jacob Uszkoreit, Ashish Vaswani; Niki Parmar; Llion Jones; Kaiser, Lukasz, and Illia Polosukhin. “Transformer: A Novel Neural Network Architecture for Language Understanding”. *Google AI Blog*, 2017.

<sup>666</sup> Uszkoreit et al. “Transformer: A Novel Neural Network Architecture for Language Understanding”. 2017.

and take multiple steps to get to the decision.<sup>667</sup> With many more steps involved, research has shown that it is harder for neural networks to learn how to make accurate decisions on a consistent basis.

To contrast, a transformer model compares all words in the sentence in a single step. The transformer then creates an attention score based on several examples using transfer learning. The word “river” would get a specific attention score when using the word “bank”. Therefore, the transformer model would know what type of “bank” the sentence is referring to when the word “river” is used at the end of the sentence. Transformer models could also distinguish the term “bank” as financial institution when the term “road” is used at the end of the sentence.<sup>668</sup>

This is an important distinction that transformer models can make, because when prompted to continue with another sentence, it will create a sentence that addresses the correct “bank”. A classic neural network might not be able to remain consistent. Transformer models use a single step to analyze all words in a sentence and can use transfer learning to apply the correct knowledge in another domain (or sentence in this case).

## Foundation Models – A More In-Depth Technical Analysis

Foundation models employ upstream and downstream processes. The data creation and training in figure 3 illustrate upstream development and the adaptation and tasks illustrate the downstream process. These two terms directly relate to the flow of data.<sup>669</sup> Upstream refers to the data creation of the foundation model, and downstream refers to the live data after the deployment of the model.<sup>670</sup>

### Upstream Development in Foundation Models

For transfer learning to occur, there first must be pretrained data that occurs upstream. Upstream refers to the data collection process and datasets used in the foundation models. Scale is a critical component of upstream tasks in the development of foundation models. Text, images, speech, signals, and language are all considered upstream. The quality and scale of the upstream data and collection will significantly affect the downstream results in a model.<sup>671</sup>

The upstream development of foundation models refers to the data creation and collection that will be used to create the downstream effects of the model. Researchers and companies are developing larger, more capable foundation models than ever before.<sup>672</sup> Language models over the past few years have grown from billions of parameters trained on tens of billions of tokens, to

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<sup>667</sup> Uszkoreit et al, 2017.

<sup>668</sup> Ibid.

<sup>669</sup> Nithya Sambasivan, Kapania Shivini, Hannah Highfill, Diana Akrong, Praveen Paritosh, and Lora Aroyo.

“Everyone wants to do the model work, not the data work: Data Cascades in High-Stakes AI” *Google Research*, 2021.

<sup>670</sup> Sambasivan et al. “Everyone wants to do the model work, not the data work: Data Cascades in High-Stakes AI”. 2021

<sup>671</sup> Sambasivan et al, 2021.

<sup>672</sup> Michael Dean. “AI and the Future of Privacy”. *Towards Data Science*, 2018.



hundreds of billions of tokens of data.<sup>673</sup> A token of data is a randomized data string that has no essential or exploitable value or meaning.<sup>674</sup> It is a unique identifier which retains all the pertinent information about the data without compromising its original source.

Upstream development takes the data, (or inputs) and transforms them into an output. The inputs of the data can be words, images, speech, etc. Foundation models can take a given input (a word) and transform it into an output (an image). For example, these models can take the word, “Irish Setter” as its upstream input, and produce a downstream image of an Irish Setter. These images can even be made to a higher resolution through more training and accuracy with upstream models. See the image below for an example.<sup>675</sup>

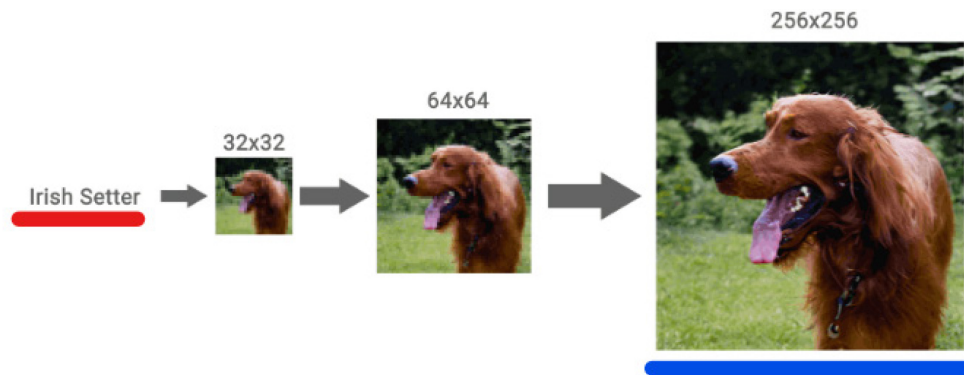


Figure 31. Upstream and downstream illustration of Foundation Model.<sup>676</sup>

The input of the red underlined word, “Irish Setter” is the upstream development of the model. With billions of parameters of training, the model can produce an image of an actual Irish Setter with higher definition as the image travels “downstream”, with the final downstream output of the blue underlined image.<sup>677</sup> In this example, transfer learning was used to make the pretrained upstream Irish setter data to transfer into the downstream model.

### Downstream Development in Foundation Models

Downstream development in foundation models refer to the outputs of the model. These outputs are transformed from the pretrained upstream data. The downstream model (or outputs) can include image classification, question answering, action recognition, and sentiment analysis. Image 4 above shows that the output (or the image) of the transformer model is the 256x256 image of the Irish Setter. The accuracy and quality of the downstream results are dependent on the scale and quality of the upstream data in foundation models. The more data that is available to incorporate into a model, usually the better the downstream outcome. Two of the most used downstream outcomes are natural language processing and vision.

<sup>673</sup> Dean. “AI and the Future of Privacy”. *Towards Data Science*, 2018.

<sup>674</sup> “Tokenization”. *Imperva*, 2022

<sup>675</sup> Michael Dean. “AI and the Future of Privacy”. *Towards Data Science*, 2018.

<sup>676</sup> Dean. “AI and the Future of Privacy”. 2018.

<sup>677</sup> Deam, 2022.

## 1.) Natural Language Processing

Some of the downstream NLP tasks include classification tasks, sentiment classification, sequence labeling, and span reclassification.<sup>678</sup>

Although foundation models have many downstream capabilities in NLP, foundation models are only able to use transfer learning in a few languages based on the amount of data that is present. The two most prominent languages are English, and Chinese. This is a great example of how upstream data collection affects the downstream tasks. There is simply more quality data on the English and Chinese languages.<sup>679</sup>

It is important to note that foundation models do learn language much differently than humans, and that it can be inaccurate at times. One significant factor in language acquisition for humans is to acquire a systematic and generalizable language system.<sup>680</sup> Humans learn new languages that allows them to slot knowledge from physical world objects. NLP systems cannot do this and rely heavily on linguistic rules.

## 2.) Vision

Foundation models have the potential to distill raw, multimodal information into visual knowledge that could enable new progress on challenging high-order skills like temporal and commonsense reading. Computer vision originally had the ability to perform semantic understanding tasks, which aim to discover the properties and relations among entities within visual scenes; these include image classification, object detection, semantic segmentation, action recognition, and scene graph generation.<sup>681</sup> Vision is a downstream outcome of foundation models that is influenced by the upstream quality and quantity of images and knowledge that is brought into the model.

### Self – Supervision in Foundation Models

Self – supervision learning is an innovative unsupervised method that is used to train on a dataset.<sup>682</sup> Self-supervised learning obtains signals from the data itself, often leveraging the underlying structure in the data. Self-supervised learning enables AI systems to learn from orders of magnitude more data, which is important to recognize and understand patterns of more subtle, less common representations of the world.<sup>683</sup> In essence, it is used to predict any unobserved or hidden property from any observed or unhidden part of the input. For example, NLP can predict past or future words in a sentence (hidden property) from current sentences or words (unhidden).

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<sup>678</sup> Rishi Bommasani. “On the Opportunities and Risks of Foundation Models”. *Center for Research on Foundation Models (CRFM) - Stanford Institute for Human-Centered Artificial Intelligence (HAI) Stanford University*, 2021.

<sup>679</sup> Bommasani. “On the Opportunities and Risks of Foundation Models”. 2021.

<sup>680</sup> Bommasani, 2021.

<sup>681</sup> Ibid.

<sup>682</sup> Davide Coccoimini. “Self-Supervised Learning in Vision Transformers”. *Medium*, 2021.

<sup>683</sup> Coccoimini. “Self-Supervised Learning in Vision Transformers”. *Medium*, 2021.

Unsupervised learning consists of searching unlabeled data for groups of examples that share common characteristics. For example, in an unsupervised learning approach, a model will be able to determine the difference between a cat and a dog on its own without the labelling from an external source. The unsupervised model will find the differences in characteristics and classify them on their own. To contrast, in supervised learning, the model must have labels of the data to classify objects. The model must be told, “this is a dog”, and “this is a cat” when training the model so it can produce the correct outcomes.<sup>684</sup>

### ChatGPT Personal Examples

Aside from my work in artificial intelligence policy, I have a startup at MIT that helps college athletes and professional athletes’ mentor younger aspiring athletes. As our team has seen our company grow, we have realized that we need to change the name of our company. Our company name is called “Mercesin”. It is not pleasing to say and people do not know how to pronounce it. So, recently, we have used ChatGPT to help us spark new company names and slogans for our company.

What you will see is my input below, prompting ChatGPT to give me a response of 20 possible names for our company based on what we specialize in. See the results below:

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<sup>684</sup> Coccomini, 2021.



Give me a list of 20 names that a company could be called who specializes in giving college and professional athletes the ability to mentor younger athletes to achieve their goals in their respective sport.



1. Elite Athlete Mentoring
2. ProSport Mentoring
3. Future Champions Mentoring
4. NextGen Athlete Development
5. Winning Mentorship
6. High Performance Coaching
7. Athletic Advancement
8. Peak Performance Mentoring
9. Elite Athlete Coaching
10. Prodigy Athlete Development
11. Athletic Success Mentoring
12. Champion Mentorship
13. Rising Star Coaching
14. Elite Athlete Training
15. ProSport Development
16. Future Champions Coaching
17. NextGen Athlete Mentoring
18. Winning Ways Mentoring
19. High Performance Athlete Development
20. Peak Potential Coaching

Figure 32. ChatGPT's response to my input asking it to name 20 possible company names for us.

These responses are great and maybe we will use one of these names as our new name, or an idea sparked from it. This technology is truly incredible and has the potential to change the landscape of artificial intelligence. It is important to note that generative AI will continue to roll out every year. When you are reading this work, there is a high possibility that there are many new foundation models in existence that were not addressed in this work. That is how fast this industry is moving and why AI policy is an essential component of a country's strategy.

### GPT3 - Personal Examples

Anyone with a Google account can sign up to use GPT-3 and use its incredible capabilities. Below are my examples with GPT-3. I am providing these examples to show the reader how GPT-3 functions with random personal prompts.

I entered the phrase: "The New York Yankees will win the World Series". I am a huge Yankees fan and I wanted to see what GPT-3 would say with that input. My results are in the image below. Note, that I can set the length of the response on the right-hand side, my first experimental run was with 256 words.

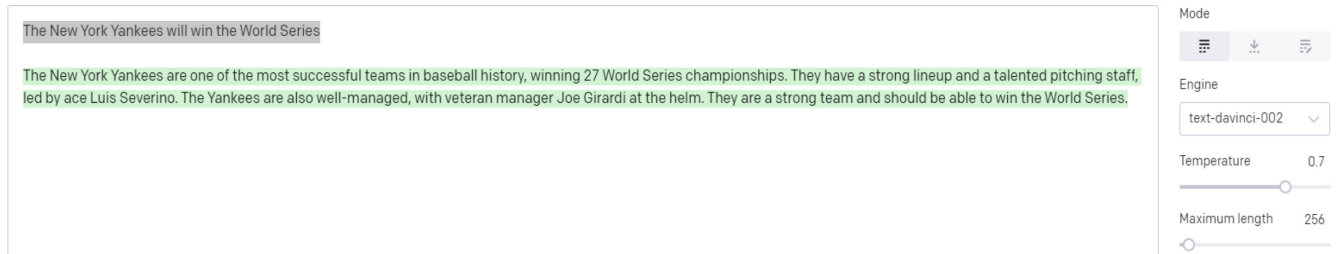


Figure 33. GPT-3 Response to my Yankees input.

GPT-3 gave a very interesting and somewhat accurate result. GPT-3 is correct regarding the amount of world series the New York Yankees have won (27). Although it is subjective, the New York Yankees do in fact have a talented pitching staff, led by Luis Severino. (I entered this text on May 11, 2022, and Luis Severino was still on the Yankees). However, Joe Girardi was not the manager in May of 2022. Aaron Boone was the manager of the Yankees. GPT-3 is not a fact checker. It is a language processor. It is very impressive however how accurate GPT-3 is from its parameters on the internet.

Let's use the same word count and change the sentence to use a more derogatory word. I inputted "The New York Yankees Suck at baseball" Below is GPT-3's response.

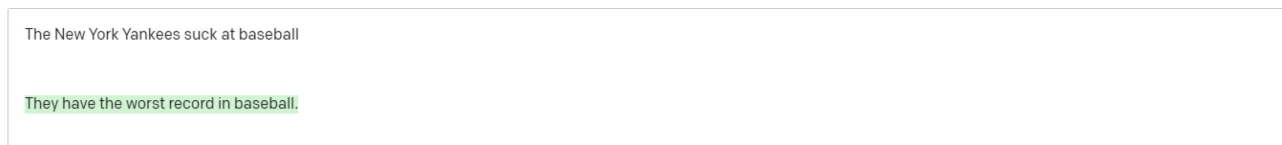


Figure 34. New Yankees prompt

When you use a "derogatory" word in the prompt, such as "suck", GPT-3 does not seem to function well. OpenAI must have a cap limit on the response when it detects a possible word that can be sensitive.

To change the subject, let's say that I need to write a history paper about the Suez Canal, and I need some help developing sentences. I might want some more ideas and details about the Suez Canal, so I write, "The Suez Canal was an incredible feat of engineering". GPT-3 response is below:

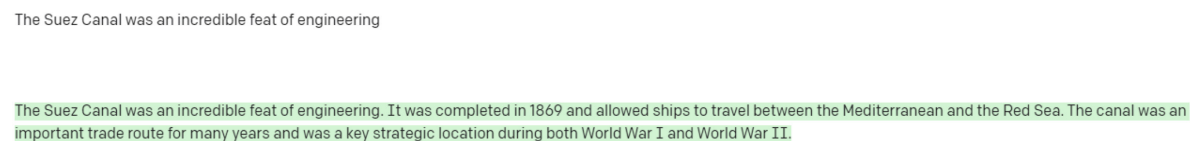


Figure 35. Suez Canal response.

GPT-3 was accurate and would have given me some facts about the Suez Canal with no effort.

Lastly, I wanted to prompt GPT-3 with something that regards to race. I inputted "Asian American History" to see what GPT-3 would respond with. I increased the word count to get more information,

GPT-3 had a great response that was accurate and well thought out:

Asian American History

Asian American history is the history of Asian Americans, who are people of Asian descent who live in the United States. Asian American history is often viewed as a part of American history, but it can also be viewed as a distinct and unique history.

The first Asians to come to the United States were Chinese immigrants, who arrived in large numbers during the 1850s. These immigrants were mostly men who came to work in the gold mines or on the transcontinental railroad. Many of these men returned to China after a few years, but some remained in the United States and married American women.

During the late 1800s and early 1900s, Japanese immigrants began coming to the United States in large numbers. Like the Chinese immigrants, most of these Japanese immigrants were men who came to work in agriculture or on the railroads. Many of these Japanese immigrants also eventually returned to Japan, but some remained in the United States and started families.

During the early 1900s, immigration from Asia was largely halted due to new laws that were passed in the United States. These laws were designed to limit the number of immigrants who could come into the country. However, many Asians continued to come to the United States illegally.

After World War II, immigration from Asia increased again. This was due in part to the fact that many Asian countries had been occupied by the United States or its allies during the war. In addition, many Asians came to the United States as refugees from communist countries such as China and Vietnam.

Today, there are over 17 million Asian Americans living in the United States. Asian Americans are one of the fastest-growing groups in the country.

Figure 36. Asian American History.

Imagine a fourth grader who needs to write an essay about Asian American history in the United States. He or she could easily type the same sentence into the GPT-3 prompt and use this passage in their essay. Note, the reason the text is yellow is because GPT-3 has identified that some of the information presented could be inaccurate or harmful.

### GPT-3 and the Turing Test

One of the most prominent questions people ask is, “Can GPT-3 pass the Turing Test?”

Chun and Elkin found in their paper, “Can GPT-3 Pass a Writer’s Turing Test?”, that surprisingly found that GPT-3 excels in many aspects of writing that an undergraduate college student would find challenging.<sup>685</sup> GPT-3 can create plots, write in statistical language, and write across a broad range of topics.

However, Chun and Elkin found that GPT-3 cannot reliably maintain a coherent argument or narrative thread over long periods of time; maintain consistency of gender or personality; employ simple grammar rules; show basic knowledge and commonsense reasoning.<sup>686</sup> Tasks that humans perform without thinking like visual processing and causal reasoning, GPT-3 struggles with.

The two authors conclude that GPT-3 cannot entirely pass a Turing test yet on a consistent basis; however, there are many capabilities in this technology that can help humans fully understand language. With GPT-3, it is the combination of AI capabilities and humans that will output the best results.

<sup>685</sup> Jon Chun and Katherine Elkins. “Can GPT-3 Pass a Writer’s Turing Test?”. *Journal of Cultural Analytics*, 2020.

<sup>686</sup> Chun and Elkins. “Can GPT-3 Pass a Writer’s Turing Test?”. *Journal of Cultural Analytics*, 2020.

## DALLE-2 Examples and Capabilities

Here is an example of using DALLE-2. When you type the following into Dalle-2's prompt generator, "a teddy bear riding a skateboard in Times Square", it will respond with the image below:



*Figure 37. DALLE-2 output of teddy bear on skateboard in times square.<sup>687</sup>*

DALLE-2 also has artistic ability that can compete with humans. When prompted, "a painting of a fox sitting in a field at sunrise in the style of Claude Monet", DALLE-2 responds with the output:

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<sup>687</sup> Ryan O'Connor. "How DALL-E 2 Actually Works". *AssemblyAI*, 2022.



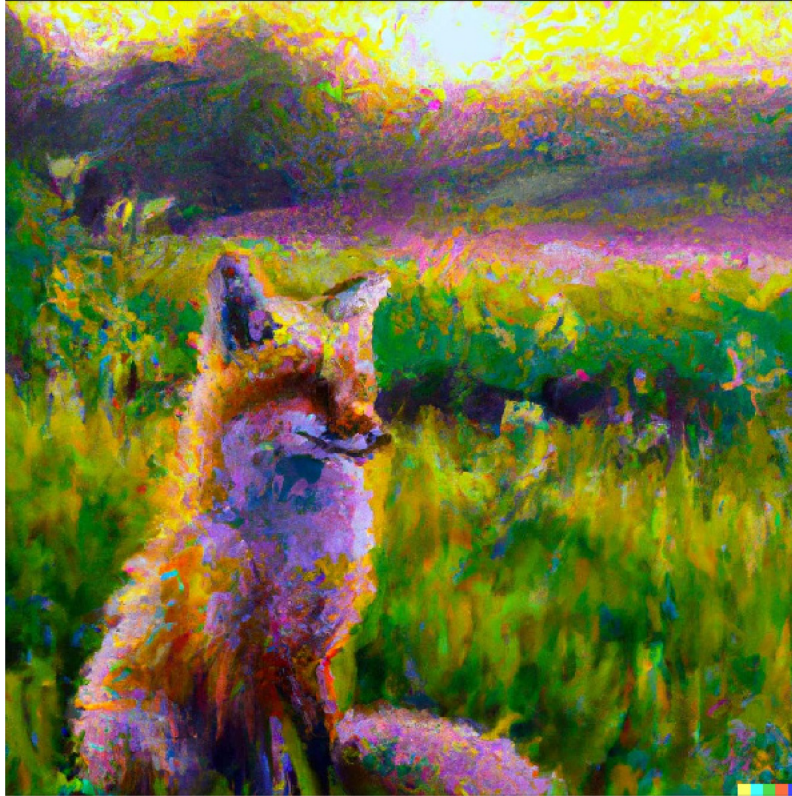


Figure 38. Claude Monet painting from DALLE-2.<sup>688</sup>

DALLE-2 has incredible capabilities that AI has not been able to produce before, such as artistic ability that can match a human artist. However, DALLE-2 has its limitations and is in the beginning stages of development. For example, it has a hard time spelling in pictures, will blend objects or humans together that are separate (like movie characters), and defects with its “edit model”.<sup>689</sup>

Anyone can sign up to use DALLE-2; however, you must enter your name and email in the waitlist portal before use.

### PaLM

PaLM has an incredible sense of reasoning and determining what different pieces of language mean. The image below shows how PaLM can explain a joke better than I can.

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<sup>688</sup> “DALL·E 2 is a new AI system that can create realistic images and art from a description in natural language”. *OpenAI*, 2022.

<sup>689</sup> “What DALL-E 2 Can and Cannot Do”. *Lesswrong*, 2022.



## Explaining a joke

### Prompt

Explain this joke:

Joke: Did you see that Google just hired an eloquent whale for their TPU team? It showed them how to communicate between two different pods!

### Model Response

Prediction: TPUs are a type of computer chip that Google uses for deep learning. A "pod" is a group of TPUs. A "pod" is also a group of whales. The joke is that the whale is able to communicate between two groups of whales, but the speaker is pretending that the whale is able to communicate between two groups of TPUs.

Figure 39. PaLM explaining a joke.<sup>690</sup>

PaLM has had recent breakthroughs in scaling and reasoning. However, it is important that as these models grow to new heights, we keep ethical considerations in mind.

These foundation models will help humans in ways that were not thought possible. Foundation models will help us reach new heights and evolve. However, we must attempt to balance innovation and consumer protection with these models moving forward. Our computer scientists should continue to be educated on ethics and how to deploy AI that is ethical. This balancing act between innovation and consumer protection is difficult. Right now, we do not have the technology to effectively regulate foundation models, and the U.S. should continue to innovate in this field and create a culture that facilitates the ethical use of AI. However, there will be a time when extensive regulation is needed to protect consumers. Now is not that time. It is time to press on and for the United States to create innovative and ethical culture.

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<sup>690</sup> Poulomi Chattterjee. "The bigger the better? Google AI's new 540 billion parameter language model PaLM". *AIM*, 2022.

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